

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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UNITARY PLAN 0.030-SCALE Corp.) 956

SPACE SHUTTLE

AEROTHERMODYNAMIC DATA REPORT



JOHNSON SPACE CENTER HOUSTON, TEXAS

DATA MANagement services SPACE DIVISION

DMS-DR-203.: NASA CR-1:8,794

VOLUME 4 OF 18

RESULTS OF TESTS OA12 AND IA9 IN THE

AMES RESEARCH CENTER UNITARY PLAN WIND TUNNELS

ON AN 0.030-SCALE MODEL OF THE SPACE SHUTTLE

VEHICLE 2A TO DETERMINE AERODYNAMIC LOADS

By

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Prepared under NASA Contract Number NAS9-13247

By

Data Management Services
Chrysler Corporation Space Division
New Orleans, Louisiana 70189

for

Engineering Analysis Division

Johnson Space Center National Aeronautics and Space Administration Houston, Texas

WI'S TUNNEL TEST SPECIFICS:

Test Numbers:

ARC 11-707 (A)

ARC 97-707 (B)

ARC 87-707 (c)

NASA Series Numbers:

TA9A, D, C and OALZA, C

Test Date:

2 April - 17 May, 1973

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This document has been reviewed and is approved for release.

FOR N. D. Kemp

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Chrysler Corporation Space Division Assumes in responsibility for the data presented herein other than its display characteristics.

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RECULTO OF TESTS OALS AND IAS IN THE

AMES RESEARCH CENTER UNITARY PLAN WIND TUNNELS

ON AN O.O3O-CCALE MODEL OF THE SPACE CHUTTLE

VEHICLE SA TO DETERMINE AERODYNAMIC LOADS

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R. H. Spangler Rockwell International

ABSTRACT

Tests were conducted in the NASA/ARC Unitary Plan Wind Tunnels during April and May 1973, on an 0.030-scale replica of the Space Shuttle Vehicle Configuration 2A. Aerodynamic loads data were obtained at Mach numbers from 0.6 to 3.5.

The investigation included Tests IA9A, B and C on the integrated (launch) configuration and Tests OA12A and C on the isolated orbiter (entry configuration). The integrated vehicle was tested at angles of attack and sideslip from -8 degrees to +8 degrees. The isolated orbiter was tested at angles of attack from -15 degrees to +40 degrees and angles of sideslip from -10 degrees to +10 degrees as dictated by trajectory considerations. The effects of orbiter/external tank incidence angle and deflected contil surfaces on aerodynamic loads were also investigated.

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Test IA97.							
Longitudinal Distribution of	CP vs X/LB	1.5	Ą	0	0	PHI, MACH, ALPHA	1-24
Orbiter Fuselage Pressures		0.5	₫	0	0		25-54
		-1.2	A	0	0	-	55-78
		0.5	ထု	Œ	0	PHI, MACH, BETA	79-102
		0.5	7-	덛	0		103-126
		0.5	0	ഥ	0		127-156
		0.5	4	阳	0		157-180
		0.5	ω	闰	0		181-304
		0.5	0	ഥ	5-		205-216
	 	0.5	0	曰	-10		117-238
		0.5	0	闰	-15) -	839-240
Longitudinal Distribution of	CP vs X/LE	1.5	А	0	0	PHI, MACH, ALPHA	402-242
External Tank Pressures	-	0.5	4	0	0		265-29h
		-1.2	₽	0	0	>>	295-318

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TIME	TYPE OF PLOT	다 아	PARAMETTERS	TERS B	4	CONDITIONS VARYING	FEGES
Longitudinal Distribution of	CP VS X/LI	0.5	တု	된	0	PHI, MACH, BETA	329-342
TYPE TOTAL TOTAL PROPERTY OF THE PROPERTY OF T		0.5	7-	闰	0		343-366
		0.5	0	闰	0	- (1 -)	367-396
		0.5	7	臼	0		397-420
		0.5	∞	ſ	0	→	421-444
Longitudinal Distribution of	CP vs X/LS	1.5	A	0	0	PHI, MACH, ALPHA	097-544
	····	0.5	A	0	0		161-480
		-1.2	Ą	0	0	->-	1481-496
		0.5	ထု	₽	0	PHI, MACH, BETA	497-512
		0.5	7	터	0		513-528
		0.5	0	떠	0		529-548
		0.5	4	딾	0		549-564
-		0.5	ω	ম	0		565-580
Chordwise Distribution of	CP VS X/CW	1.5	Ą	0	0	T/BW, MACH, ALPHA	966-E86
Upper and Lower Surrace wing Pressures		0.5	Ą	0	0		597-516
•		-1.2	Ą	0	0	- 2-	C17-53.
<u> </u>		0.5	æ	色	٥	Y/BW, MACH, BETA	840-669

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CONDITIONS	X/BW, M				Z/BV, MACH,	Z/BV, M											
بو بو	0	0	0	0	0	0	0	0	0	0	i,	1	1,	-10	-10	-10	-15
Parameters	田	闰	闰	Ħ	0	闰	된	ഥ	戶	띰	뙤	臼	된	闰	ы	Þ	臼
PARAM	7	0	7	ω	Ą	ထု	7-	0	4	ω	φ	0	Φ	φ	0	∞	φ
io 1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
TYPE OF PLOT	CP VS X/CW				CP vs X/CV												→
TILI	Distribution	Upper and Lower Surface Wing Pressures			Chordwise Distribution of Left	and Right Surface Vertical Tail Pressures		•			,						-

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and Hight Surface Vertical Tail Pressures	>-	0.5	ω	闰	-15	Z/BV, MACH, BETA	S85-89E
Orbiter Base Pressures	CP vs ALPHA	0.5	A	0	0	MACH, ALPHA	893-903
Orbiter Base Pressures	CP vs BETA	0.5	0	[2-1	0	MACH, BETA	903 - 912
Upper MPS Nozzle Pressures	CP vs ALPHA	0.5	щ	0	0	PHI, MACH, X/INP	913-917
Ugper MPS Wozzle Pressures	CP vs BETA	0.5	0	[±4	0	PHI, MACH, X LMP	318-9 22
OMS Nozzle Pressures	CP vs ALPHA	0.5	щ	0	0	PHI, MACH X/LNW	729-536
OMS Nozzle Pressures	CP vs BETA	0.5	0	<u> </u>	0	PHI, MACH X/LW	528-932
SRM Booster Base Pressures	CP vs ALPHA	0.5	æ	0	0	PHI, MACII, X/LS	755-556
SRM Booster Base Pressures	CP vs BETA	0.5	0	ĒΉ	0	PHI, MACH, X/LS	175 - BBG
External Tank Base Pressures	CP vs ALPHA	0.5	Д	0	0	PHI, MACH, X/LZ	とまるよ
External Tank Base Pressures	CP vs BETA	0.5	0	Ēτ	0	PHI, MACH, X/LT	SEC-350
Test IA9B							
Longicudinal Distribution of	CP vs X/LB	0.5	Ą	0	0	PHI, MACH, ALPHA	
Orbiter Fusetage Fressures	 !	0.5	8	ы	0	РНІ, МАСН, ВЕТА	(r)
-	-	0.5	4	٢٦	0	-	(1) (1) (1)

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TITLE PARAMETERS CONDITIONS PARAMETERS CONDITIONS PAGES								
of CP vs X/LB 0.5 0 I 0 FHI, MACH, BETA 0.5 -4 I 0 0.5 -8 I 0 0.5 0 E -15 0.5 0 E 15	ш	TYPE OF PLOT		RAME	TERS B	æ R	CONDITIONS VARYING	PAGES
of CP vs X/LM	itudinal Distribut 1 of	ΛS	0.5	0	Н	0	MACH,	37-45
CP VS X/LM 0.5 -8 I 0 CP VS X/LM 0.5 0 E -10 0.5 0 E -10 0.5 0 E 15 0.5 0	ter Fuselage Pressures 		0.5	7 -	Н	0	······································	79-61
CP VS X/LT			0.0	ထု	Н	0		51-15
CP vs X/LT		·	0.5	0	편	-15	-	75-84
CP vs X/LT			0 n ,	0	⊨	-10		85-96
CP VS X/LIP	*		0.5	0	E	15		97-108
0.5 8 I 0 PHI, MACH, BETA 0.5 4 I 0 0.5 -4 I 0 0.5 -4 I 0 0.5 -8 I 0 PHI, MACH, ALFEA 0.5 8 I 0 PHI, MACH, ALFEA 0.5 8 I 0 PHI, MACH, ALFEA 0.5 0 I 0 PHI, MACH, ALFEA 0.5 0 I 0 PHI, MACH, BETH	itudinal Distribution of	CP VS X/LT	0.5	Ą	0	o	PHI, MACH, ALPHA	021-601
CP vs X/LS O.5 -4 I O O.5 -8 I O PHI, MACH, ALFER O.5 8 I O PHI, MACH, ALFER O.5 8 I O PHI, MACH, ALFER O.5 0 I O PHI, MACH, BETH	rnal Tark Pressures		0.5	∞	Н	0	MACH,	251-121
CP vs X/LS			0.5	4	1-1	0		777-381
CP vs x/IS 0.5 A 0 0 PHI, MACH, ALFHA 0.5 B I 0 PHI, MACH, ALFHA 0.5 B I 0 PHI, MACH, ALFTA 0.5 B I 0 PHI, MACH, BETA 0.5 0 I 0 PHI, MACH, BETA			0.5	0	H	0		50000
CP vs X/IS 0.5 A 0 0 PHI, MACH, ALPHA 0.5 B I 0 PHI, MACH, ALPHA 0.5 B I 0 PHI, MACH, ALPHA 0.5 b I 0 PHI, MACH, BETH			0.5	7-	Н	0		257-168
CP vs X/LS 0.5 A 0 0 PHI, MACH, ALPHA 0.5 8 I 0 PHI, MACH, ALFTA 0.5 4 I 0 PHI, MACH, BETH 0.5 0 I 0 PHI, LACH, BETH		->	0.5	ထု	Н	0		109-180
0.5 8 I 0 PHI, MACH, ALFTA 0.5 4 I 0 PHI, MACH, BATH 0.5 0 I 0 PHI, LACH, BATH	ا جائناتاتاتاتاتاتاتاتاتاتاتاتاتاتاتاتاتاتا	CP VS X/LS	0.0	Ą	0	0		(1) (1) (1) (1) (1)
4 I O PHI, MACH, BETH O I O PHI, LACH, BETH	Booster Pressures		0.5	ω	Н	0	MACH,	
O I O PHI, TACH, BEER			0.5	#	Н	0		400 - 100 -
			0.5	0	Н	0		505-600

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tion of	CP vs X/IS	0.5	7	Н	0	PHI, MACH, BETA	213-220
SRM Booster Pressures		0.5	ထု	н	0	РНІ, МАСН, ВЕТА	221-228
ਰ	CP vs X/CW	0.5	₫ "	0	0	Y/BW, MACH, ALPHA	. 229-236
Upper and Lower Surface Wing Pressures	·	0.5	₹ ∞	н	ဂ	Y/BW, MACH, BETA	257-244
		0.5	4	н	0		245-252
		0.5	0	⊢ ;	0		253-260
*********		0.5	7	н	0		392-193
-	 -	0.5	φ	н	0		<u> 269-276</u>
of	CP vs X/CV	0.5	¥	0	0	Z/BV, MACH, ALPHA	277-384
Left and Right Surface Vertical Tail Pressures	,	0.5	ω	н	0	Z/BV, MACH, BETH	38 5- 393
		0.5	- 7	н	0		υρε- ε δε
-		0.5	0	н	0		301-308
		0.5	7-	н	0	***************************************	505-805
······································		0.5	φ	н	0		755-LE
		0.5	φ	E)	-15		(A), (D)) (F), (F), (F)
-		0.5	0	<u>ы</u>	-15	-	048-888

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Tut	TYPE OF PLOT	10	PARAMETERS	LERS B	6 R	CONDITIONS VARYING	PAGES
Chordwise Distribution of	CP vs X/CV	0.5	ω	田	-15	Z/BV, MACH, BETA	341-348
Left and Right Surface Vertical Tail Pressures		0.5	φ	딸	-10		349-356
		0.5	0	Þ	-10		357-364
		0.5	ω	闰	-10		365-372
		0.5	φ	闼	15		373-380
		0.5	0	囶	15	<u> </u>	381-388
		0.5	α	딢	15	-	389-396
Orbiter Base Pressures	CP vs ALPHA	0.5	ф	0	0	MACH, ALPHA	397-400
Orbiter Base Pressures	CP vs BETA	0.5	0	ರ	0	MACH, BETA	401-104
Upper MPS Nozzle Pressures	CP vs ALPHA	0.5	щ	0	0	PHI, MACH, X/LMP	904-504
Upper MPS Nozzle Pressures	CP VS BETA	0.5	0	೮	0	PHI, MACH, X/LINP	407-TO4
OMS Nozzle Pressures	CP vs ALPHA	0.5	ф	0	0	PHI, MACH, X/LAW	409-410
OME Nozzle Pressures	CP VS BETA	0.5	0	ರ	0	PHI, MACH, X/LIW	411-415
SRM Booster Base Pressures	CP vs ALPHA	0.5	М	0	0	PHI, MACH, X/LS	414-817
SRM Booster Base Pressures	CP vs BETA	0.5	0	ರ	0	PHI, MACH, X/LS	415-416
External Tank Base Pressures	CP vs ALPHA	0.5	щ	0	0	PHI, MACH, X/LT	417-118
External Tank Rase Pressures	CP vs BETA	0.5	0	೮	0	PHI, MACH, X/LT	419-400

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Test IA9C Longitudinal Distribution of Orbiter Fuselage Pressures	CP vs X/LB	0.5	Ą	0	0	PHI, MACH, ALPHA	421-438
		0.5	ထု	闰	0	PHI, MACH, BETA	439-456
. 	 	0.5	7	闰	0		427-124
		0.5	0	터	0		764-524
a and a decided		0.5	#	闰	0		493-510
<u></u>		0.5	œ	Ħ	0		511-528
		0.5	0	떰	-15		529-546
		0.5	0	困	-10		547-564
Longitudinal Distribution of	CP vs X/LT	0.5	Ą	0	0	PHI, MACH, ALPHA	565-582
External Tank Pressures		0.5	ထု	闰	0	PHI, MACH, BETA	583-600
		0.5	4-	터	0		601-618
		0.5	0	田	0		619-636
	·	0.5	†	덛	0	* * * * * * * * * * * * * * * * * * * *	637-654
	-	0.5	∞	E	0		655-672

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TITIE	TYPE OF PLOT	10 10	PARAMETERS	TERS B	€ R	CONDITIONS VARYING	PAGES
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SEM Booster Pressures		0.5	φ	되	0	PHI, MACH, BETA	969-589
<u>.</u>	***************************************	0.5	†	闰	0	-	801-169
		0,5	0	阳	0		709-720
		0.5	4	Ħ	0		721-732
		0.5	ω	Ħ	0	->-	733-744
	CP vs X/CW	0.5	Ą	0	0	Y/BW, MACH, ALPHA	745-756
Upper and Lower Surface Wing Pressures		0.5	φ	钶	0	Y/BW, MACH, BETA	757-767
		0.5	7	Ħ	0		768-780
	<u>-</u>	0.5	0	闰	0		781-792
		0.5	4	Ы	0		793-804
	-	0.5	ω	闰	0	-	805-816
Chordwise Distribution of	CP vs X/CV	0.5	Ą	0	0	Z/BV, MACH, ALPHA	817-828
Left and Right Surface Vertical Tail Pressures		0.5	φ	闰	0	Z/BV, MACH, BETA	829-840
		0.5	7	Ħ	0		841-852
		0.5	0	ഠ	0		853-864
***	-	0.5	#	ы	0	-	865-876

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Chordwise Distribution of	CP vs X/CV	0.5	æ	臼	0	Z/BV, MACH, BETA	877-888
Left and Right Surface Vertical Tail Pressures		0.5	φ-	Þ	-15		989-900
		0.5	0	Ħ	-15		901-912
		0.5	8	闰	-15		913-924
-1- (MAC-19)		0.5	φ	钶	-10		925-936
		0.5	0	闰	-10		937-948
	≯	0.5	ω	闰	-10		096-646
Orbiter Base Pressures	CP VS ALPHA	0.5	ф	0	0	MACH, ALPHA	996-196
Orbiter Base Pressures	CP vs BETA	0.5	0	Ħ	0	MACH, BETA	967-972
Upper MPS Nozzle Pressures	CP vs ALPHA	0.5	ф	0	0	PHI, MACH, X/LMP	973-975
Upper MPS Nozzle Pressures	CP vs BETA	0.5	0	Ħ	0	PHI, MACH, X/LNP	816-918
CMS Nozzle Pressures	CP vs ALPHA	0.5	щ	0	0	PHI, MACH,X/LNW	979-981
OMS Mozzle Pressures	CP vs BETA	0.5	0	Ħ	0	PHI, MACH, X/LINM	186-586
SRM Booster Base Pressures	CP vs ALPHA	0.5	щ	0	0	PHI, MACH, X/LS	985-987
SRM Booster Base Pressures	CP vs BETA	0.5	0	Ħ	0	PHI, MACH, X/LS	988-990
External Tank Base Pressures	s CP vs ALPHA	0.5	щ	0	၁	PHI, MACH, X/LT	991-993
External Tank Base Pressures	s CP vs BETA	0.5		Ħ		PHI, MACH, X/LT	966-166

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VOLIME 6								
Longitudinal Distribution of	CP vs X/LB	ບ	0	0	0	0	PHI, MACH, ALPHA	42−τ
Orbiter Fuselage Pressure		0	Ь	0	C	0	PHI, MACH, BETA	25-36
		10	م	0	0	0		37-48
		80	دا	0	0	0		09-64
	,	0	M	0	-10	0		61-78
***		0	M	0	-20	0		96-62
-		0	П	10	0	0		97-108
		0	X	-10	0	ဂ		951-601
		0	×	-20	0	0		127-144
	>	0	×	0	0	40		145-162
Chordwise Distribution of	CP vs X/CW	ບ	0	0	0	0	Y/BW, MACH, ALFHH	163-178
Upper and Lower Surface Wing Pressures		0	در	0	0	0	Y/BW, MACH, BETA	381-621
	, <u>, , , , , , , , , , , , , , , , , , </u>	10	۵	0	0	0		137-194
***************************************		20	b	0	0	0		195-202
->	-}- -	0	Н	10	0	0	-}-	203-210

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Opper and Lower Surrace wing Pressures		20	н	10	0	0		219-226
		0	×	-10	0	0	-	227-238
		10	×	-10	0	0		239-250
		20	×	-10	0	0		251-262
		0	×	-50	0	0	 	263-274
		10	×	-20	0	0	- 5, 10 - 0 -	275-286
- *		80	×	-20	0	0	≯~	287-298
Chordwise Distribution of	CP vs X/CV	ບ	0	0	0	0	Z/BV, MACH, ALPHA	41€-66€
Vertical Tail Pressures	<u> </u>	0	دا	0	0	0	Z/BV, MACH, BETA	315-323
		10	م	0	0	0		323+330
		20	٦	0	0	0		331-338
Marie Carlo		0	×	0	-10	0		339-350
		10	×	0	-10	0	-	351-362
		50	×	0	-10	0		363-374
		0	×	0	-50	0	*	375-386

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Chordwise Distribution of	CP vs X/CV	10	×	0	-20	0	Z/EV, MACH, BETA.	387-398
Left and Right Surface Vertical Tail Pressures		20	×	0	-20	0		399-110
		0	×	0	0	70		411-422
		10	Ħ	0	0	70		423-434
	-	20	M	0	0	040	*	735-446
Orbiter Base Pressures	CP vs ALPHA	ບ	0	0	0	0	MACH, ALPHA	054-744
Orbiter Base Pressures	CP vs BETA	0	ы	0	0	O	MACH, BETA	457-154
Upper MPS Nozzle Pressures	CP vs ALPHA	ပ	0	0	0	0	PHI, MACH, X/LNP	455-456
Upper MPS Nozzle Pressures	CP vs BETA	0	b	0	0	0	PHI, MACH, X/LNF	457-458
OMS Nozzle Pressures	CP VS ALPHA	ပ	0	0	0	0	PHI, MACH, X/LANY	459-460
OMS Wozzle Pressures	CP vs BETA	0	دا	0	0	0	PHI, MACH, X/LANI	797-194
Test OA12C								
Longitudinal Distribution of	CP VS X/LB	Ð	0	0	0	04	PHI, MACH, ALPHA	453-480
Orbiter Fuselage Pressures 	····	0	M	0	-20	04	PHI, MACH, BETA	864-184
		10	×	0	-20	70	-	499-516
		20	×	0	-20	7,0	>	517-534

INDEX OF DATA FIGURES (CONTINUED)

TILL	TYPE OF PLOT	8	В	PARAMETERS	ETTERS OR	å RF	CONDITIONS VARYING	PAGES
Longitudinal Distribution of	CP vs X/LB	30	×	0	0	C4	PHI, MACH, BETA	535-552
Orbiter Fuselage Pressures 	· · · · · · · · · · · · · · · · · · ·	0	×	10	0	70	· · · · · · · · · · · · · · · · · · ·	553-570
		0	Ħ	-20	0	04		571-583
-		0	Ħ	-40	0	04	- }	909-685
	CP VS X/CW	А	0	0	0	7:0	Y/BW, MACH, ALPHA	607-618
Upper and Lower Surface Wing Pressures		0	×	0	-20	70	Y/BW, MACH, BETA	619-630
		10	×	0	-20	01		631-642
		50	Z	0	-20	70		643-654
		30	×	0	0	1 00		999-559
	· = 4, · . · · · ·	0	M	91	0	70		929-299
		10	×	10	0	70		679-690
		20	×	10	0	- 1	*****	€91-703
		0	Ħ	-20	0	7,0	•	417-607
		10	×	-20	0	04		715-726
		20	×	-20	0	70		727-738
-4 -		0	Ħ	04-	0	70	``	739-750

INDEX OF DATA FIGURES (CONTINUED)

TITLE	TYPE OF PLOT	8	8	PARAN de	PARAMETERS 6e ⁰ r	♣RF	CONDITIONS VARYING	PAGES
	CP vs X/CW	10	×	-70	0	70	Y/BW, MACH, BETA	751-762
Upper and Lower Surface Wing Pressures		30	×	04-	0	710	Y/BW, MACH, BETA	763-77h
Chordwise Distribution of	CP vs X/CV	А	0	0	0	70	Z/BV, MACH, ALPHA	775-786
Left and Right Surface Vertical Tail Pressures		0	×	0	-20	04	Z/BV, MACH, BETA	787-798
		70	×	0	-20	70		799-810
		20	×	0	-20	040		811-822
		30	×	0	0	04		458-513
>		30	×	0	-20	7,0	->-	835-846
Orbiter Base Pressures	CP vs ALPHA	А	0	0	0	710	MACH, ALPHA	347-850
Orbiter Base Pressures	CP vs BETA	0	Z	0	-20	0.4	MACH, BETA	
Upper MPS Nozzle Pressures	CP vs ALPHA	А	0	0	0	70	PHI, MACH, X/LMP	355-356
Upper MPS Mozzle Pressures	CP vs BETA	0	M	0	03-	7,0	PHI, MACH, X/LME	857-858
OMS Nozzle Pressures	CP vs ALPHA	А	0	0	O	7,0	PHI, MACH, X/LING	859-860
O.IS Hozzle Pressures	CP VS BETA	0	Ħ	0	02-	7,0	PHI, MACH, X/LIE	361-862

INDEX OF DATA FIGURES (CONCLUDED)

PARAMETER SCHEDULES:

<u>ALPHA</u>

- A) -4, 0, 4, 8 Degrees
- B) -8, -6, -4, -2, 0, 2, 4, 6, 8 Degrees
- c) -4, 0, 5, 10, 15, 20, 22.5 Degrees
- D) 0, 5, 10, 15, 20 Degrees

BETA

- E) -4, 0, 4, 8 or -4, 2, 4, 8 Degrees
- F) -8, -6, -4, -2, 0, 2, 4, 6, 8 Degrees
- G) -7, -5, 3, 5, 7, 9 Degrees
- H) -8, -6, -4, -2, 2, 4, 6, 8 Degrees
- I) -5, 5, 7, 9 or -6, 4, 6, 8 Degrees
- J) -10, -5, 5, 10 Degrees
- K) -8, -4, 0, 4, 8 Degrees
- L) -10, 0, 10 Degrees
- M) -6, -3, 0, 3, 6 Degrees

INTRODUCTION

The 0.030-meals Aero Loads Space Chuttle model was tested in the Unitary Plan Wind Tunnels at ARC starting April 2, and continuing through May 17, 1973 as follows:

IA9A	11-foot Transonic	April : to April 14, 1973
OA12A	11-foot Transonic	April 16 to April 79, 1973
IA9C	8x7-foot Supersonic	April 23 to May 1, 1973
OA12C	8x7-foot Supersonic	May 2 to May 8, 1973
IA9B	9x7-foot Supersonic	May 9 to May 17, 1973

The testing was conducted in all three legs of the Unitary Plan Wind Tunnels to obtain a Mach number range from 0.6 to 3.5. Aerodynamic loads data were obtained for the ascent and entry configurations. The effects of control surface deflections were also investigated.

This report consists of 3 volumes of force data and 15 volumes of pressure data for a total of 18 volumes arranged in the following manner:

VOLUME NO.	CONTENTS
1 3 4 5 6 7	IA9A force data IA9B and IA9C force data OA12A and OA12C force data IA9A plotted pressure data IA9B and IA9C plotted pressure data OA12A and OA12C plotted pressure data IA9A tabulated pressure data (a) orbiter fuselage (b) orbiter base
8	(c) upper MPS nozzle IA9A tabulated pressure data (a) OMS nozzle
9	(b) body flap (c) OMS pcd outside (d) lower wing surface IA9A tabulated pressure data (a) upper wing surface (b) left vertical tail surface (c) right vertical tail surface
10	(d) APU inlet (e) SRM booster base IA9A tabulated pressure data (a) SRM booster (b) external tank (c) external tank base

INTRODUCTION (CONTINUED)

11	IA9B ta	bulated pressure data
	(a)	orbiter fuselage
	\b\{b\}	orbiter base
	(c)	upper MPS nozzle
		OMS nozzle
	(e)	body flap OMS pod outside
	(g)	
12		bulated pressure data
	(a)	upper wing surface
	(b)	left vertical tail surface
	(c)	right vertical tail surface
	(a)	APU inlet
	(e)	SRM booster base SRM booster
	(f)	SRM booster
	(g)	external tank
		external tank base
13	IA9C ta	bulated pressure data
		orbiter fuselage
	(b)	orbiter base
	(c)	upper MPS nozzle
	(d)	OMS nozzle
	(e)	upper MPS nozzle OMS nozzle body flap
	(f)	OMS pod outside
14		bulated pressure data
	(a)	lower wing surface
	(b)	upper wing surface
	(c)	left vertical tail surface
	(d)	right vertical tail surface
1 5	IA9C ta	bulated pressure data
	(a)	APU inlet
	(p)	SRM booster base SRM booster external tank
	(c)	SRM booster
	(4)	CRUCITICE OCHIE
	(e)	
16	OAl2A t	abulated pressure data
	(a)	orbiter fuselage
	(b)	orbiter base
	\c\	upper MPS nozzle OMS nozzle
	(a)	OMS nozzle
	(6)	nogh trab
	(f)	OMS pod outside

INTRODUCTION (CONCLUDED)

17	OAl2A tabulated pressure data	
	(a) lower wing surface	
	(b) upper wing surface	
	(c) left vertical tail surfa	ec
	(d) right vertical teil muri	
	(e) APU inlet	
18	OAl2C tabulated pressure data	
	All components	

NOMENCLATURE General

SYMBOL	EADSAC CYMBOL	DEFINITION
a		speed of sound; m/sec, ft/sec
$c_{\mathbf{p}}$	CF	pressure coefficient: $(p_{ m q} - p_{ m m})/q$
М	MACH	Mach number; 9/a
Þ		pressure; N/m², psi
વ	((NSM) (PSF)	dynamic pressure: 1/CpV2, N/m2, psf
RN/L	RI./L	unit Reynolds number; per m, per ft
V		velocity; m/sec, ft/sec
α	ALPHA	angle of attack, degrees
β	BETA	angle of sideslip, degrees
ψ	PSI	angle of yaw, degrees
ϕ	PHI	angle of roll, degrees
ρ		mess density; kg/m ³ , slugs/ft ³
	<u>F</u>	Reference & C.G. Definitions ,
Ab		base area; m^2 , ft^2
b	BREF	wing span or reference span; m, ft
c.g.		center of gravity
ℓ _{REF}	LREF	reference length or wing mean serodynamic chord; m, ft
s	CREF	wing area or reference area; m^2 , ft ²
	MRP	moment reference point
	XMRP	moment reference point on X exis
	YMRP	moment reference point on Y axis
	ZMRP	moment reference point on Z axis
SUBSCRI	PTS	
ს 1		base local
3		static conditions
t oo		total conditions free stream
*		

NOMENCLATURE (Continued)

Body-Axia System

SYMBOL	SADCAC SYMBOL	DEFINITION
c^{M}	CN	normal-force coefficient; normal force
$\mathbf{c}^{\mathbf{r}}$	CA	axial-force coefficient; axial force
c _Y	CY	side-force coefficient; side force
Cip	CAB	base-force coefficient; base force -Ab(pb - pp)/45
$c_{\mathtt{A}_{\mathbf{f}}}$	CAF	forebody axial force coefficient, ${\rm C}_{\mbox{\scriptsize A}}$ - ${\rm C}_{\mbox{\scriptsize A}_{\mbox{\scriptsize b}}}$
C _m	CLM	pitching-moment coefficient; pitching moment qS/REF
c_n	CYN	yawing-moment coefficient; Ynwing moment qSb
c l	CBL	rolling-moment coefficient; rolling moment
		Stability-Axic System
$c_{\mathtt{L}}$	CL	lift coefficient; lift qS
c^{D}	CD	drag coefficient: drag qS
c_{D_b}	CDB	base-drag coefficient; base drag
$c_{\mathtt{D}_{\mathbf{f}^{*}}}$	CDF	forebody dreg coefficient; C_D - C_{D_b}
$\mathbf{c}_{\mathbf{Y}}$	CY	side-force coefficient; side force
$c_{\mathbf{m}}$	CII4	pitching-moment coefficient; pitching moment ${}^{qS} \boldsymbol{\ell}_{REF}$
C ₁₎	CLN	youIng-nement coefficient; yowing moment
C.	CCIT	rolling-moment coefficient; rolling moment
L/1)	L/D	Lift-to-drug ratio; $c_{\rm L}/c_{\rm D}$
$L/D_{\mathbf{f}}$	I/DF	lift to Porebody drag ratio: $c_{\mathrm{L}}/c_{\mathrm{Dr}}$

NOMENCLATURE (CONTINUED)

ADDITIONS TO STANDARD LIST

SYMBOL	PLOT SYMBOL	DEFINITION
ø R	RUDUER	rudder, surface deflection angle, positive deflection, trailing edge to the left; degrees.
∂ e	FLEVON	elevon, surface deflection angle, positive deflection, trailing edge down; degrees.
$oldsymbol{\delta}_{ ext{RF}}$	RUDFIR	rudder flare, split rudder deflection angle, left split rudder trailing edge left and right split rudder trailing edge right, $\delta_{\rm RF} = (\delta_{\rm RL} + \delta_{\rm RR})/2$, positive deflection; degrees.
io	ORBINC	incidence angle between the orbiter and external tank, $i_0 = \alpha_t - \alpha_t$; degrees.
$oldsymbol{eta}_{'\!1}$	BETAL	angle of sideslip of external tank.
$oldsymbol{lpha}_{ m T}$	ALPHAT	angle of attack of external tank.
ℓ _B	LB	length of orbiter body; in.
$m{\ell}_{ ext{T}}$	LT	length of external tank; in.
l s	LS	length of SRM booster; in.
$\ell_{ m M4}$	INM	length of QMS nozzle, positive direction forward of exit plane; in.
$\ell_{ m NP}$	LNP	length of MPS nozzle, positive direction forward of exit plane; in.
b / 2	BW	wing semi-span; in.
$\mathfrak{b}_{\mathbf{v}}$	BV	vertical tail span; in.
x	x	distance from component nose; in.
у	Y	lateral distance from centerline; in.

NOMENCLATURE (CONCLUDED)

SYMBOL	PLOT SYMBOL	DEFINITION
Z	7.	vertical distance measured from W.L. 500 (vertical tail reference root chord); in.
C _W	CW	local wing chord; in.
$c_{\mathbf{v}}$	CV	local vertical tail chord; in.
x/ $\ell_{\rm B}$	x/lb	longitudinal position/orbiter body length.
×/ / T	x/lt	longitudinal position/external tank length.
x/ / 3	x/ls	longitudinal position/booster length.
x/ L NM	x/lm	longitudinal position/OMS nozzle length.
x/ℓ_{NP}	x/lnp	longitudinal position/MPS nozzle length.
x/c _w	X/CW	local chordwise position/local wing chord length.
x/c _v	x/cv	local chordwise position/local vertical tail chord length.
y/ b/2	$\mathbb{Z}\backslash\mathbb{B}\mathbb{A}$	local spanwise position/wing semi-span.
z/b _v	Z/BV	local spanwise position/vertical tail span.

CONFIGURATIONS INVESTIGATED

The 0.030-scale aero loads model was a replica of the Space Shuttle. Vehicle 2A. It consisted of four major components: the orbiter, the external oxygen and hydrogen tank (FT) and two solid rocket boosters (SRB).

On the ascent configuration, the orbiter was strut mounted from the ET on a Task Corporation MK XVI 2.5-inch diameter internal balance. The left SRB was strut mounted from the ET on a Task Corporation MK XXII 1.5-inch diameter internal balance. No attempt was made to simulate actual inter-attachments. The ET was sting mounted to the tunnel model support system on a Task Corporation 4.0-inch diameter internal balance. The right SRB was strut mounted symetrically to the left side, but did not contain a balance. The orbiter configuration, designated as O2A, consisted of B10C5D7W87V5R5M3F4.

The entry configuration consisted of the isolated orbiter, sting mounted to the tunnel model support system on a Task Corporation MK XXA 2.5-inch diameter internal balance. Midway through the OAL2C test, the MK XXA balance was damaged and was replaced by the MK XXB for the high angles of attack. The orbiter was provided with deflectable elevons by means of interchangeable brackets, deflectable rudder by means of a pin-indexed hinge, and interchangeable rudders to obtain different speed brake flare angles. The main propulsion system engines were removed during entry configuration testing to provide sting clearance. A cover plate was provided for the strut clearance hole.

The orbiter was instrumented with 374 pressure orifices on the left wing, left side of the fuselage, vertical tail, left OMS pod and engine, left and upper MPS engine and the base. The pressures were measured using eleven Scanivalve, Inc., S-type valve modules mounted internally (a five and a six gang unit). When tested in the entry configuration, the MPS pressures were not available for measurement.

The left side of the ET was instrumented with 136 pressure orifices. These pressures were measured by means of 7 Scanivalve, Inc., S-type valve modules configured as one unit of 6 modules and one single. These valves were mounted internally in the tank. The left SRB had one gang of six S-type modules to measure 102 pressures. The right SRB was not instrumented. The pressure transducers used in the valve modules were Statham PM 131 TC differential pressure transducers, with ranges of ±10 psid, ±12.5 psid and ±15 psid. Reference and calibration pressures were measured by the ARC micro manometers.

Some modifications were made to the model at the test site prior to

CONFIGURATIONS INVISITIGATED (CONTINUED)

testing. These were as follows:

- 1. The forward tip of the ET containing the retro rocket package (Reference NR Drawing VL72-000018) was replaced with a flush 0.90 inch radius nose (Model scale). The new nose had five pressure taps; one in the nose and four more aft of the nose on the vertical and horizontal axis on a 0.315 inch radius.
- ?. The ET balance cavity was enlarged by one inch on the diameter (from 5 inches to 6 inches) to provide clearance for cable routing and eliminate balance interference.
- 3. The clearances around both the orbiter and the SRB struts were opened to approximately 1/8 inch to prevent interference.
- 4. An alternate rudder hinge pin was provided to give a rudder deflection of +15 degrees.

Before and during the tests various model discrepancies developed or were discovered. These were generally minor and had only a negligible, if any, effect on the data. Significant discrepancies are noted below:

- Pressure orifices P171 and P173 on the OMS pod base were omitted.
- 2. During the test certain pressure taps developed leaks or became plugged. Data from these taps are questionable and should be used with caution. Difficulties in checking may have resulted in erroneous indications of leakage. Repairs were made to correct leaking or plugged pressure instrumentation, whenever possible, as the test progressed. The following list gives those taps that were indicated as bad on the various leak and response checks:

ARC Facility	Run Nos.	Orifice numbers with questionable pressure data
11'	2-4	70, 163, 427
	5-118	31, 100, 103, 163, 201, 407
	119-160	16, 98, 101, 107, 333, 427
*	161-170	16, 98, 101, 107, 333, 427 + 306, 307, 327, 328, 336, 337, 356, 357, 375

CONFIGURATIONS INVESTIGATED (CONCLUDED)

ARC Facility	Run Nos.	Orifice numbers with questionable pressure data
11' 	171-1 82	16, 47, 53, 75, 78, 98, 107, 201, 236, 237, 238, 307, 327, 365, 427
¥	183-189	Same as (171-182) + 7, 447, 525
	190-211	Same as (171-182)
8 ' x7 '	220-234	20, 21, 24, 74, 326, 327, 336, 424, 427, 752, 868, 871
	235 - 285	74, 326, 327, 336, 424, 427, 752, 868, 871
	286-300	74, 107, 115, 124, 129, 138, 326, 327, 336, 427
	301-305	74, 326, 327, 336, 427
Y	306-333	74, 326, 327, 427
9 'x 7'	340-396	5, 325, 326, 327, 424, 427, 526, 752, 868, 871

TEST FACILITIES DESCRIPTION

Ames 11 x 11-Ft. Transonic

The Ames 11 x 11-Foot Transonic Wind Tunnel is a variable density, closed return, continuous flow type. This tunnel has an adjustable nozzle (two flexible walls) and a slotted test section to permit transonic testing over a Mach number range continuously variable from 0.4 to 1.4.

Ames 8 x 7-Ft. Supersonic

The Ames 8×7 -Foot Supersonic Wind Tunnel is a closed-return, variable-density tunnel with a 8- by 7-foot rectangular test section. The nozzle has flexible side walls with fixed upper and lower surfaces. Mach number range is continuously variable from 7.45 to 3.5. Tunnel stagnation pressure can be varied from 0.3 to 2.0 atmospheres and Reynolds number per foot varies from 1.0×10^6 to 5.0×10^6 .

Ames 9 x 7-Ft. Supersonic

The Ames 9 x 7-Foot Supersonic Wind Tunnel is a variable density, continuous flow type with an adjustable nozzle to permit supersonic testing over a Mach number range continuously variable from 1.5 to 2.5. The nozzle is of the asymmetric, sliding-block type in which the variation of the test section Mach number is achieved by translating, in the streamwise direction, the fixed-contour block that forms the floor of the nozzle.

DATA REDUCTION

Standard procedures were utilized to reduce force and pressure date to coefficient form. The following dimensional constants were applied:

Reference Dimensions and Constants (Model Scale)

@Ref. = 0.401 ft ²	Orbiter reference area
$\rho_{\text{vor.}} = 39.849 \text{ in.}$	Orbiter reference length
Pasc Areas (Model Scale)	
^A BOI = 0.1903 Ft ²	Orbiter base area, invegrated
$A_{BOA} = 0.2360$	Orbiter base area, sting mounted
$f_{\text{EMPSU}} = 0.0417$	Orbiter upper MPS base area
$\Lambda_{\text{EMPGL}} = 0.0853$	Orbiter lower MPS base area
A _{BACPS} = 0.0310	Orbiter ACPS base area on OMS pod
$A_{BOMS} = 0.0231$	Orbiter OMS nozzle base area
$A_{BPOD} = 0.0257$	Orbiter OMS pod base area
$A_{CO} = 0.0611$	Orbiter sting cavity base area
$A_{\rm BNOZ} = 0.0564$	SRM nozzle base area
$A_{BSKIRT} = 0.1729$	SRM nozzle skirt base area
A _{BETT} = 0.3189	ET Base area
A _{CET} = 0.1964	ET Sting cavity base area

TEST : OAI2 / FA9

TABLE I.

DATE: May, 1973

TEST CONDITIONS

MACH NUMBER	REYNOLDS NUMBER (per unit length)	DYNAMIC PRESSURE (pounds/sq. 100t)	STAGNATION TEMPERATURE , (degrees Fahrenheit)
0,6	4.0 X 14.6	540	120° NOM.
0,9	4.5	800	
1.1	4.0	800	
1.25	3.0	630	
1.4	3.0	650	
1,55	2,8	600	
2.0	2.3	490	
2.5	1.5	300	
3.0	7.0	3.50	<u> </u>
3,5	2.0	3 00	
			

FIVE (5) TASK CORPORATION BALANCES

BALANCE UTILIZED: WITH CAPACITIES AS FOLLOWS:

ISULATED ORBITER MKTTA MKX 3000 3000 NF 3000 3000 NA 1500 1500 YF 1500 1500 YA X 600 600 4000 4000 2.5" .2.5" 5/2E

ENTECRA ORB MK 100	TED VE SLB MKJS	HICLE ET MKIIB
2400	1250	4000
2400	1250	4000
1200	500	2000
12.00	500	2000
1500	wo	1000
4000	1000	10,000
2.5"	1.5"	4.0"

COMMENTS: THE MARK IXA, 2.4N DIA. BALANCE WAS

DAMAGED AFTER RUN 319. THE MARK IXB WAS

SUBSTITUTED FOR RUN 320 AND SUBSEQUENT RUNS

T: ETT

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TABLE II. CONTINUED

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$\alpha_{\text{A}} = \text{MAX}, 0, 5, 10, 15, 20, 25$ $\beta_{\text{B}} = -10, -5, 5, 10$ $\beta_{\text{B}} = -10, 0, 10$ $\beta_{\text{B}} = -10, 0, 10$ $\beta_{\text{B}} = -10, 0, 10$. 1.1.	4 4 4		3	‡	4	1	1	4	بعدونقل	terret	1 1 1	A TOVAR	┨	VAR (2)	Š
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TABLE II. CONCLUDED

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TABLE III. MODEL COMPONENT DIMENSIONAL DATA

MODEL COMPONENT: Blo Body		
GENERAL DESCRIPTION: Fuselage, 2A Config	uration, Lightweigh	t Orbiter, per
Rockwell Lines VL70-000089 "B."		
Scale Model = .030	•	
DRAWING NUMBER: VL70-000089 "B		
DIMENSIONS:	FULL-SCALE	MODEL SCALE
Length IN	1328.3	39.8490
Max. Width $\sim IN$ (eX ₀ = 1528.3)	265.0	7.9500
Max. Depth $\sim IN$. (61% = 1480.52)	248.0	7.4400
Fineness Ratio	5.012	5.012
Area_Ft2		•
Max. Cross-Sectional	456.4	.41076
Planform		
Wetted		•
Base	e proprieta	

MODEL COMPONENT: Canopy - C5		
GENERAL DESCRIPTION: 2A Configuration pe	er Lines VL70-000092	
Scale Model = .030	•	
DRAWING NUMBER: VL70-000092		
DIMENSIONS:	FULL-SCALE	MODEL SCALE
Length (STA FWD Bulkhead)	<u>391.0 ·</u>	11.730
Max. Width (T.E. Bulkhead)	560.0	16,800
Max. Depth (WP = 42.9 22 to =	500)	•
Fineness Ratio		
Area		•
Max. Cross-Sectional		
Planform		······································
Wetted	description of the second	·
; Base	· · · · · · · · · · · · · · · · · · ·	:

MODEL COMPONENT:	Manipulator Housing D-7		·
GENERAL DESCRIPT:	ION: 2A Configuration per	Rockwell Lines VL	70-00093
			
Scale Model = .	030	••	٠
DRAWING NUMBER:	VL70-000093	_	
DIMENSIONS:		FULL-SCALE	MODEL SCALE
Length ~ I	n.	881.00	26.430
Max. Width	~IN.	51.00	1.530
Max. Depth	~IN.	23.00	.690
Fineness R	atio		
Area			
Max.	Cross-Sectional		
Planf	orm		
Wette	d	• *************************************	
Base		•	
D Fuselage	BP = 0.00	Service of the servic	- 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
• •	WP = 500.0 IN. FS	•	
	V 10/ 0 4 - 3000 0 70 B	•	•

MODEL COMPONENT: WING-W87 New Light Weight Orbite		
GENERAL DESCRIPTION: Orbiter Configuration Per Line	es VL70-000093.	
NOTE: (Dihedral Angle is defined at the lower sur		at the 75.33%
element line projected into a plane perpendiculary	•	
Scale Model = .030		0.00000
TEST NO.	DWG. NO. VL7	0-00093
DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA Area (Theo.) Ft2 Planform Span (Theo In. Aspect Ratio Rate of Taper Taper Ratio Dihedral Angle, degrees Incidence Angle, degrees Aerodynamic Twist, degrees Sweep Back Angles, degrees Leading Edge Trailing Edge 0.25 Element Line Chords: Root (Theo) B.P.0.0. Tip, (Theo) B.P. 46834 MAC Fus. Sta. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC EXPOSED DATA Area (Theo) Ft2 Span, (Theo) In. BP108 to 468.341 Aspect Ratio Taper Ratio Chords Root BP108 Tip 1.00 b MAC Fus. Sta. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC W.P. of .25 MAC Airfoil Section (Rockwell Mod NASA) XXXX-64 Root b = .425 Tip b = 1.00 Data for (1) of (2) Sides	2690.00 936.68 2.265 1.177 0.200 3.5000 3.000 3.500 45.00 -10.24 35.209 689.24 137.85 474.81 1136.89 299.20 182.13 1752.29 720.68 2.058 .2451 562.40 137.85 393.03 1185.31 300.207 143.76	2.42100 28.10040 2.265 1.177 0.2000 3.500 +3.000 +3.000 -10.24 35.209 20.67720 4.13550 14.24430 34.10670 8.97840 5.46390 1.57706 21.62040 2.058 .2451 16.8720 4.13550 11.79090 35.55930 9.00621 4.31280 .10
Data for (1) of (2) Sides Leading Edge Cuff Planform Area Ft2 Leading Edge Intersects Fus M. L. @ Sta Leading Edge Intersects Wing @ Sta	120.33 560.0 1035.0	.10830 16.80 31.050

MODEL COMPONENT: Elevon E-18		
GENERAL DESCRIPTION: 2A Configuration Per Data for (1) of (2) Sides	W-87 Rockwell Line	. vi. 70-00093
Scale Model = .030		
DRAWING NUMBER: VI. 70-000093		
DIMENSIONS:	FULL-SCALE	MODEL SCALE
Area ~ Ft ²	205.52	.18497
Span (equivalent) ← IN.	353.34	10.60020
Inb'd equivalent chord	114.78	3.44340
Outb'd equivalent chord	55.00	1.6500
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord		208
At Outb'd equiv. chord	.400	400
Sweep Back Angles, degrees	•	·
Leading Edge	0.00	0.00
Tailing Edge	_10.24	_10.24
Hingeline	0.00	0.00
	Ft3 1548.07	.04180

MODEL COMPONENT: VERTICAL - V5	(Light Weight Orbi	ter Configuration	1)
GENERAL DESCRIPTION: Centerline	Vertical Tail, Dou	ble Wedge Airfoil	with Rounded
Leading Edge			
Scale Model = .030			
DRAWING NUMBER:	VL70 000095		
DIMENSIONS:		FULL-SCALE	MODEL SCALE
TOTAL DATA			
Area (Theo) Ft ² Planform Span (Theo) In Aspect Ratio Rate of Taper Taper Ratio Sweep Back Angles, degrees Leading Edge Trailing Edge O.25 Element Line Chords: Root (Theo) WP Tip (Theo) WP MAC Fus. Sta. of .25 MAC W. P. of .25 MAC		413.25 315.72 1.675 0.507 .404 45.000 26.249 41.130 268.50 108.47 199.81 1463.50 635.522	.37192 9.47160 1.675 0.507 .404 45.000 26.249 41.130 8.05500 3.25410 5.99430 43.90500 19.06566
B. L. of .25 MAC Airfoil Section Leading Wedge Angle Trailing Wedge Angle Leading Edge Radius Void Area Ft ² Blanketed Area Ft ²	Deg Deg IN.	10.000 14.920 2.00 13.17 12.67	0.00 10.000 14.920 .06 .01185 .01140

MODEL COMPONENT: R-5 Rudder		-
GENERAL DESCRIPTION: ZA Configuration per Roc	kwell Lines V	L 70-00095
Scale Model = .030		-
DRAWING NUMBER: VL 70-00095		
DIMENSIONS:	FULL-SCALE	MODEL SCALE
Area ~ Ft ²	106.38	.09574
Span (equivalent) ∼IN.	201.0	_6.030
Inb'd equivalent chord	91.585	2.71.755
Outb'd equivalent chord	50.833	1.52499
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.400	0.400
At Outb'd equiv. chord	0.400	0.400
Sweep Back Angles, degrees	•	
Leading Edge	34.83	34.83
Tailing Edge	26.25	26.25
Hingeline	34.83	34.83
Area Moment (Normal to hinge line)~Ft3	526.13	.01421

MODEL COMPONENT: OM	S Pod -M3	•	
	A Light Weight Conf	iguration per Rock	well Lines
V1.70-00094A			
Scale Model = .030		·.	·
DRAWING NUMBER:	VL70-00094A	-	
DIMENSIONS:		FULL-SCALE	MODEL SCALE
Length	•	346.0	_10.380
Max. Width $x_{} =$	1450.0	108.0	3.240
Max. Depth $X_0 =$	1500.0	113.0	3.390
Fineness Ratio	٠.,		•
Area	•		•
Max. Cross-Se	ectional		
Planform			
Wetted			
Pase of OMS Pod	•••	A contract of the contract of	
P = 463.9 IN. FS WP 40	00 + 63.9 = 463.9		•

BP = 80.0 IN. FS

Length 1214.0 to 1560.0' = 346.0 IN. FS

MODEL COMPONENT: FL Body Flap	•	
GENERAL DESCRIPTION: 2A Configuration per Rockwell Lines VL70-000094A Scale Model = .030 DRAWING NUMBER: VL70-000094A	70-00094A	
Scale Model = .030	•	
DRAWING NUMBER: VL70-00	0094A	•
DIMENSIONS:	FULL-SCALE	MODEL SCALE
Length	84.70	2.541
Max. Width	265.00	7.950
Max. Depth	· _ 	•
Fineness Ratio	· · · · · · · · · · · · · · · · · · ·	
Area ~ Ft ²	•	•
Max. Cross-Sectional	-	
Planform	142.64	.12838
Wetted		
- Base Ft ²	38.65	.03478

MODEL DIMENSIONAL DATA

MODEL COMPONENT : S3-Booster Solid Roc		
GENERAL DESCRIPTION: 2A Configuration & VL72-000061 "B"	Per Rockwell Li	nes VL77-000012
Body of Revolution; Data for (1) of (2) Sides	
Scale Model = .030		
DRAWING NUMBER: VL 77-000012	······································	
DIMENSIONS :	FULL SCALE	MODEL SCALE
Length ~IN.	1732.0	51.96
Max Width (DIA) IN. BSRM Tank	142.0	4.260
Max Depth (DIA) Aft Skirt	Prince 2A Configuration Per Rockwell Lines VI77-000012	
Fineness Ratio L/D		
Area ~ Ft ²		
		MODEL SCALE 51.96 4.260 7.77 6.687 .32928
Wetted		
Base		•
		RM

BP (Orbiter) = 0.00 = 243.0 IN. BSRM

TABLE III. (CONCLUDED)

MODEL COMPONENT: EXTERNAL TANK - T	19	
	•	
GENERAL DESCRIPTION: 2A Configuration	on	
NOTE: T9 identical to T8 W/O retro	okg., nose w/30"R F.S.	
DRAWING NUMBER NONE		
DIMENSION:	FULL SCALE	MODEL SCALE
Length - IN.	1858	55.740
Max Width (Dia) - IN.	324.0	9.720
Max Depth		
Fineness Ratio L/D	5.73457	5.73457
Area - FT ²		•
Max Cross-Sectional	572.56	0.51530
Planform	· · · · · · · · · · · · · · · · · · ·	
Wetted		· · · · · · · · · · · · · · · · · · ·
Base		•
Nose, Radius, IN.	30.0	. •

ORBITER BODY

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ATTON	135									•			•		•					135	144	152	160	168		
RADIAL LOCATION 0	120		1	30	33	84	23		;	89		80	88	96	104	112		121	127	134	143	151	159	167	173	174
RADTA	110																								171	172
	105																			133	142	150	158	166		
	90	ű	77	53	æ.	17	26			29		79	87	95	103			120	1.26	132	177	611	157	165		
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	55			27	36	15	54			65		77														
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STATTON	MODEL	6.00	06.3	6.75	7.35	8.40	11.40	12.00	12.30	12.90	13.80	15.00	16.80	18.75	21.75	26.40	29.40	32.40	35.40	37.35	39.00	41.25	42.90	04.44	45.90	45.90
ORBITER	FULL	200	210	950 100	545	280	380	100	710	430	091	500	260	625	725	380	980	1030	1136	1245	1300	1375	1430	1480	1530a	1530 ^b

a OMS POD, INSIDE b OMS POD, OUTSIDE

a. Orbiter body
Table IV. Pressure Orifice Locations

OFBITEF BASE

NUMBERS	1, 2, 3, 4 6 7 8 9 11, 12, 13, 14 15, 16
LOCATION	CRRITSP BASE (INTEGRATED) LEFT NPS NCICLE BASE ANDE AREA ON OWS POD ONS NCIZLE BASE ONS POD BASE TEBLIER BASE TEBLIER BASE TEBLIER BASE TEBLIER BASE

9 ~ DEG 0 40 175 176	
0 7	
STA. X MODEL 47.40	
ORB. S ~ X FULL 1580	

BODY FLAP LWR SURFACE

_			
		270	186 192 197
		225	1.85 191 196
	DEG	180	184 190 1 9 5
<u>ы</u>	υ ~ θ	135	163 189 194
MPS NOZZLE		90	182 188 193
MPS		0	181 187
	X ~ IN. FWD BASE	MODEL	0.75 1.50 225
	X . EWE	FULL	25 50 75

		225	179
	θ ~ DEG	180	178 180
OMS NOZZLE	. 0	135	177
CIMIS	X ~ IN FWD BASE	MODEL	0.30
	X ~ IN FWD BA	FULL	10

TAIL
VERTICAL

WATE	WATER PLANE $\sim { m Z}_{ m O}$	2°		×	, ~ 2/x	THEORETICAL VERTICAL CHORD	TTCAI	. VER	FICAL	CHORE	
FULL	MODEL	AL		0	.05	.15	.30	.52	.65	.775	٠ 9
525	15.75	.079.		001							
550	16.50	.158	니떠	110	115 114	412 512	413 513	414 514	415 515	416 51é	
009	18.00	.316	I H	42C	421 521	1,22 522	1 ₂₃ 523	127 127	125 525	426 526	1427 527
069	20.70	09•	그ㄸ	064	431 531	432 532	43 <u>3</u> 53 <u>3</u>	1134 534	435 535	1;36 536	437 537
765	22.95	₹8.	.H #	044	145 144	442 542	143 543	442 444	44 5 545	346 546	747 747
792	23.76	.925	니타	450	15 5	452 552	453 553	454 554	455 555	456 556	45? 557

b. Orbiter Base, Body Flap Lower Surface, and Vertical Tail

Table IV. (ontinued.

ORBITER WING

5	ORBITTER B.P	F - T									2	Theor	ETTA	THECAPTICAL WING CHORD	CHORC									
TOL	MODEL	4		6 9 −	35	25	15	033	0.0	.05	.15	.25	04.	.55	.60	.65	.70	.725	.75	. 775	.e	. 65	9,	.95
140	1.20	. 299	D 1	20C	201 301		202 303			203 303		20% 30*		205 305					306	.,	201 5.7	20g 30c		203 305
0_4	5.10	.364	ры			210	311			212														
300	6.00	134.	ьч					220		ឆ្ក	222 322		323	224 324					225 325	3.8	226 ; 326	327 3	222 328	229 329
250	7.50	.594	티						230	231 3%	232	233 333	23k 33k	235				236 336		237 337		23E 2 338 3	239 339	240 340
315	9.45	.673	្រុ						250	251 351	252 352	253 353	25k 35k	255 355			256 356			257 357		258 35:		259 359
365	10.95	.780	u I						260	261 361	26 2 362	263				18.78			365			366		267 367
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c. Orbiter Wing Table IV. Continued.

EXTERNAL TANK

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d. External Tank Table IV. Continued.

LEFT SRM

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e. Left SRM

Table IV. Concluded.

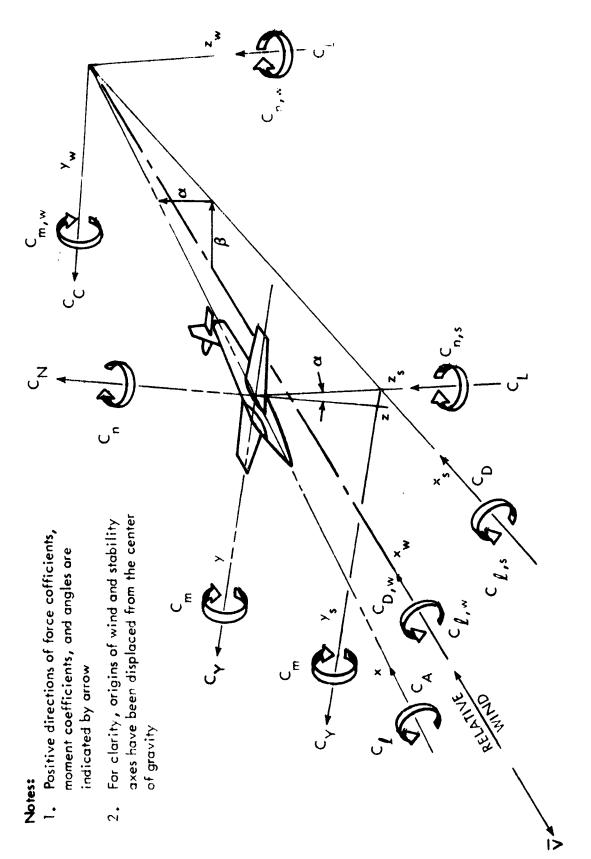


Figure 1. - Axis Systems.

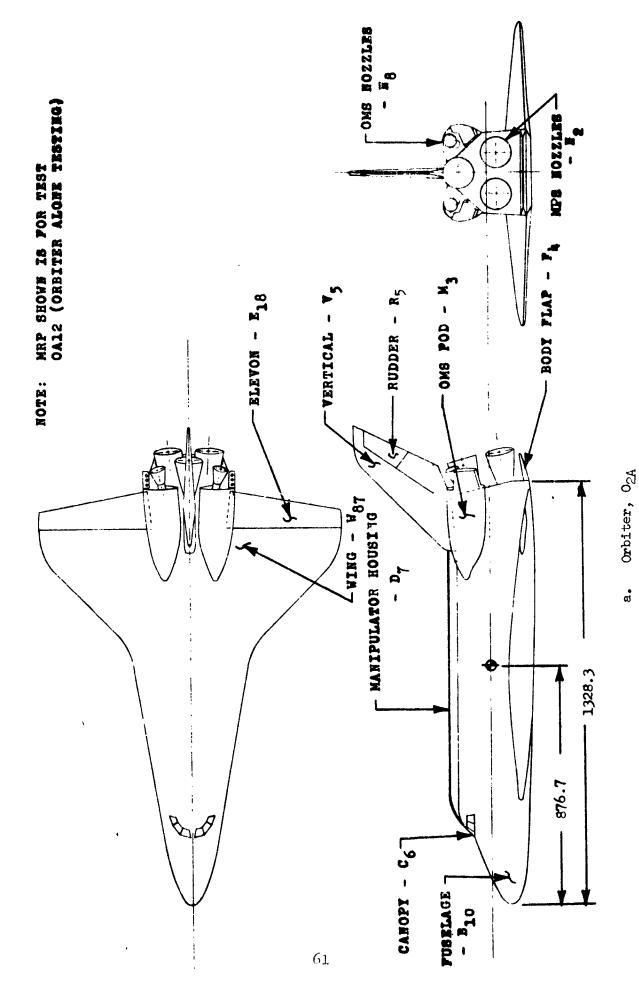
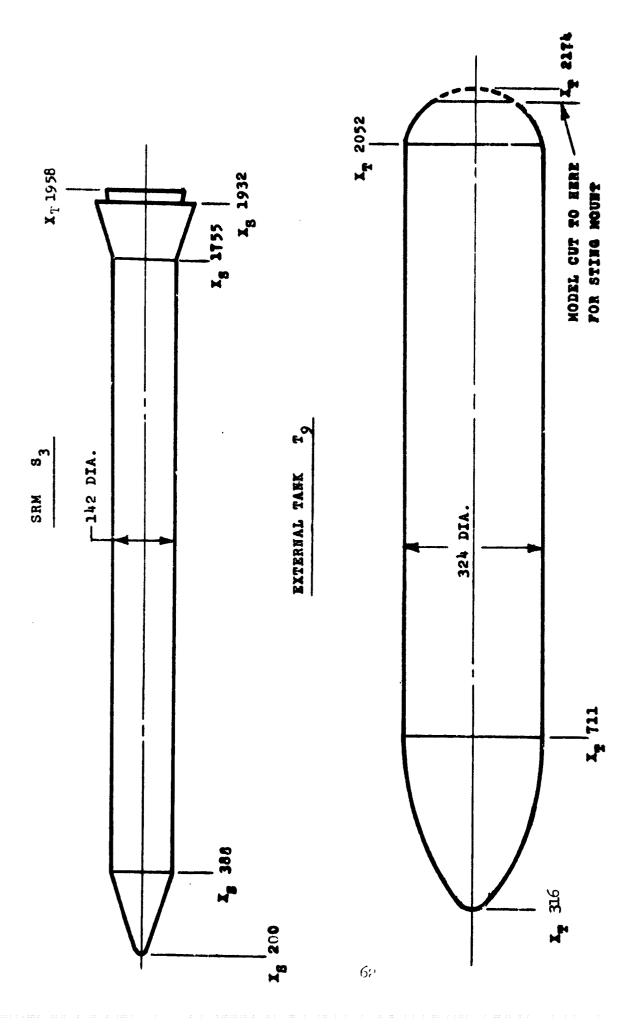
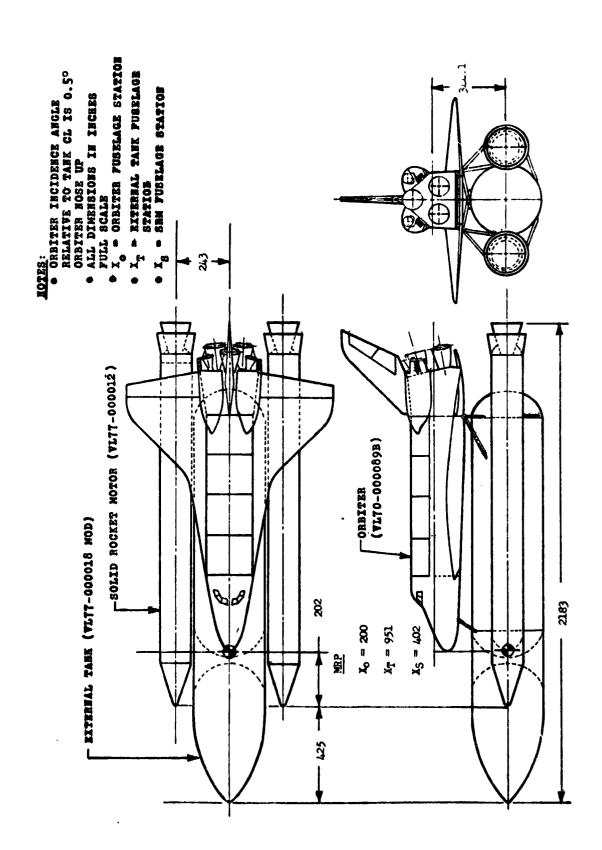


Figure 2. - Model Sketches.



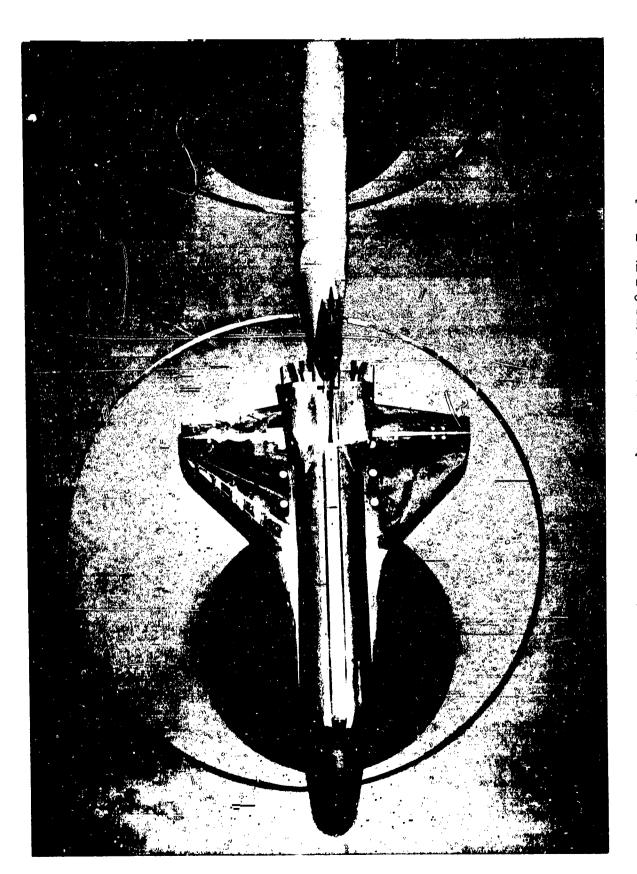
b. SRM, S₃, and External Tank, T₉
Figure 2. - Continued.



c. Integrated Vehicle Figure 2. - Concluded.



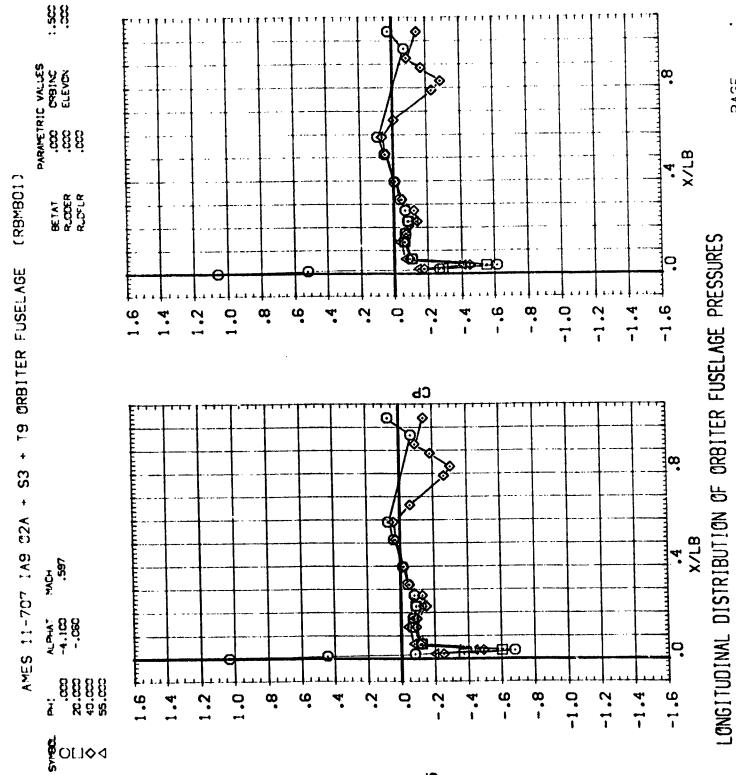
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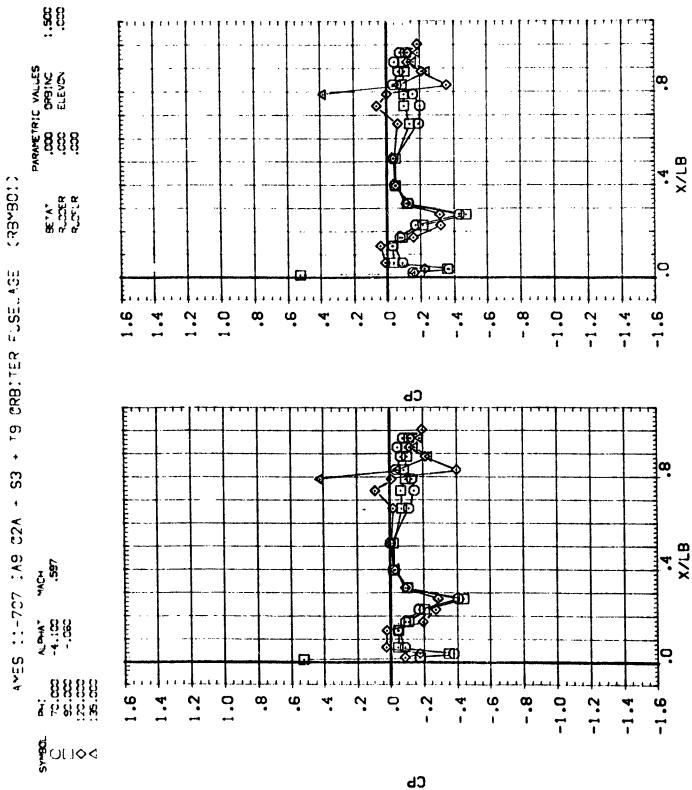
b. Isolated Orbiter (Entry Configuration) Mounted in the ARC 8x7 Ft. Tunnel Figure 3. - Concluded.

DATA FIGURES



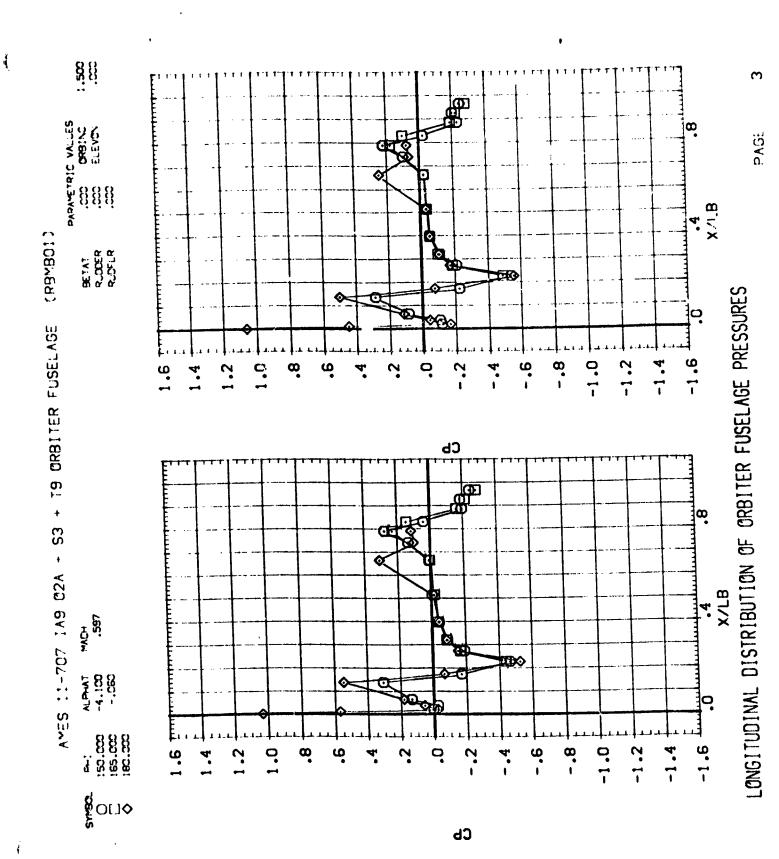


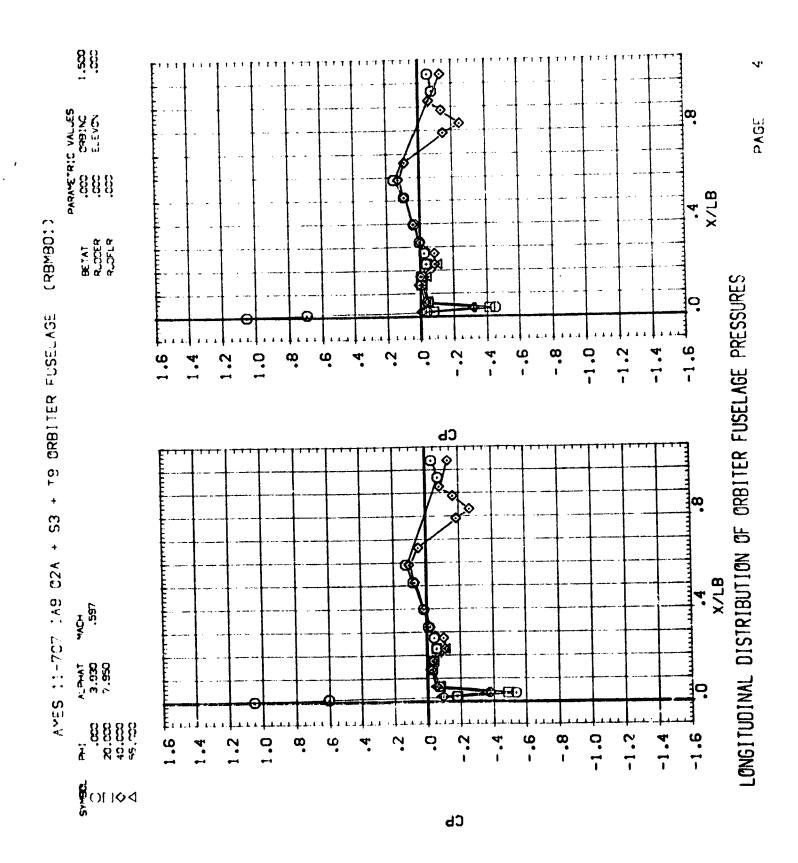
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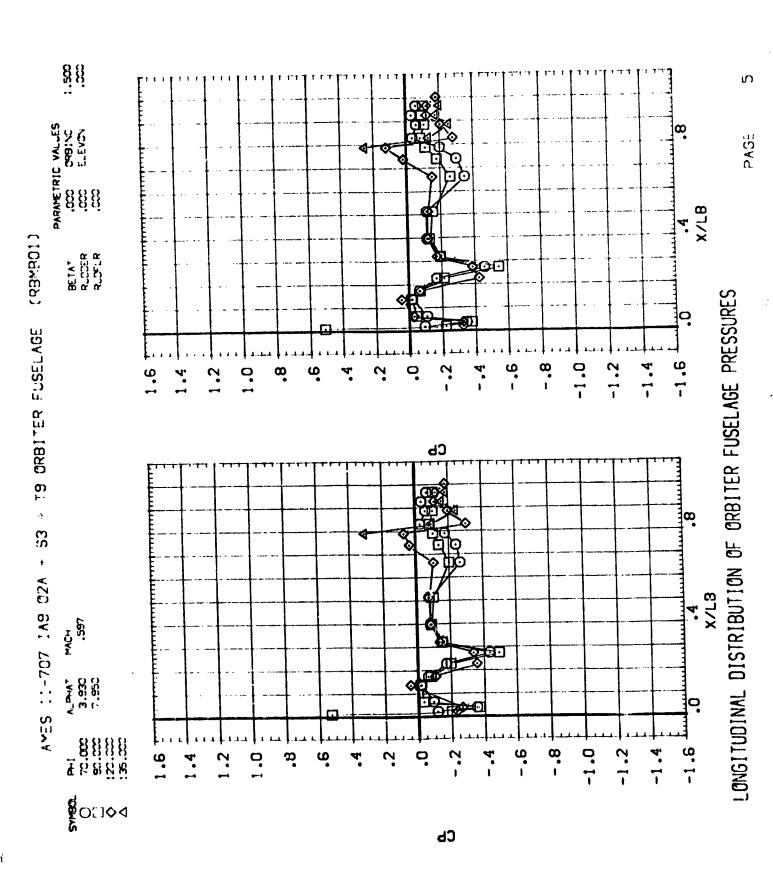


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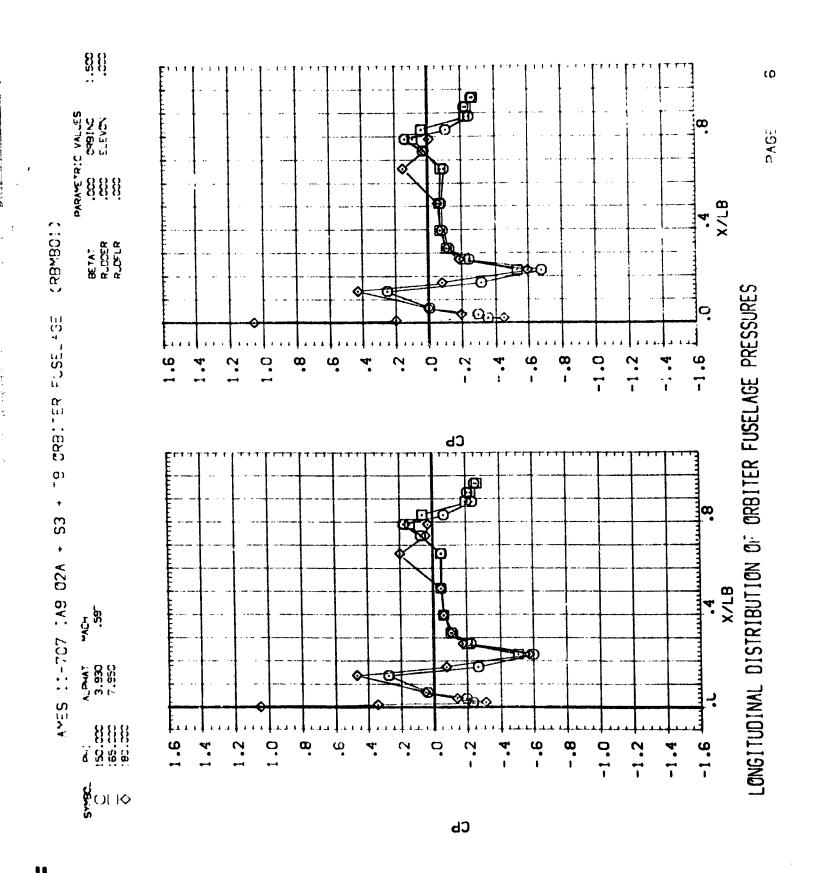
LONGITUDINAL DISTRIBUTION OF ORBITER FUSELAGE PRESSURES

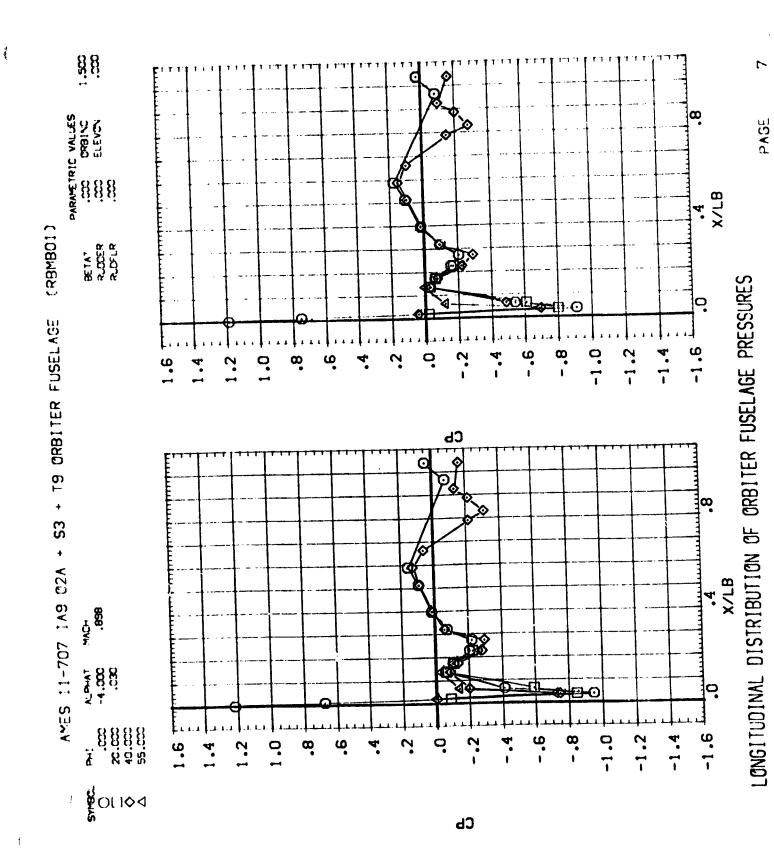


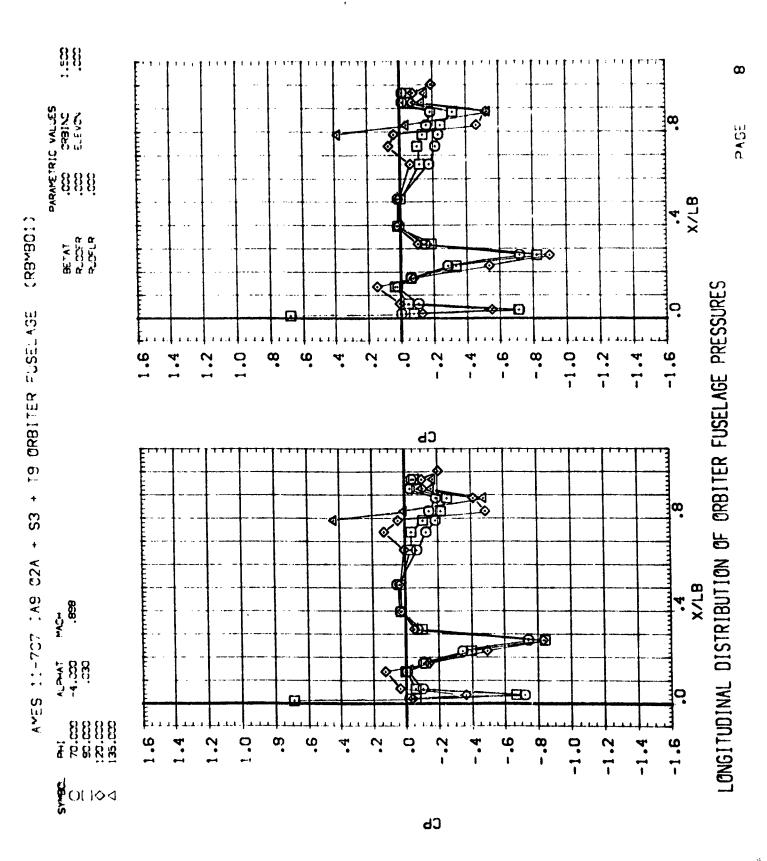


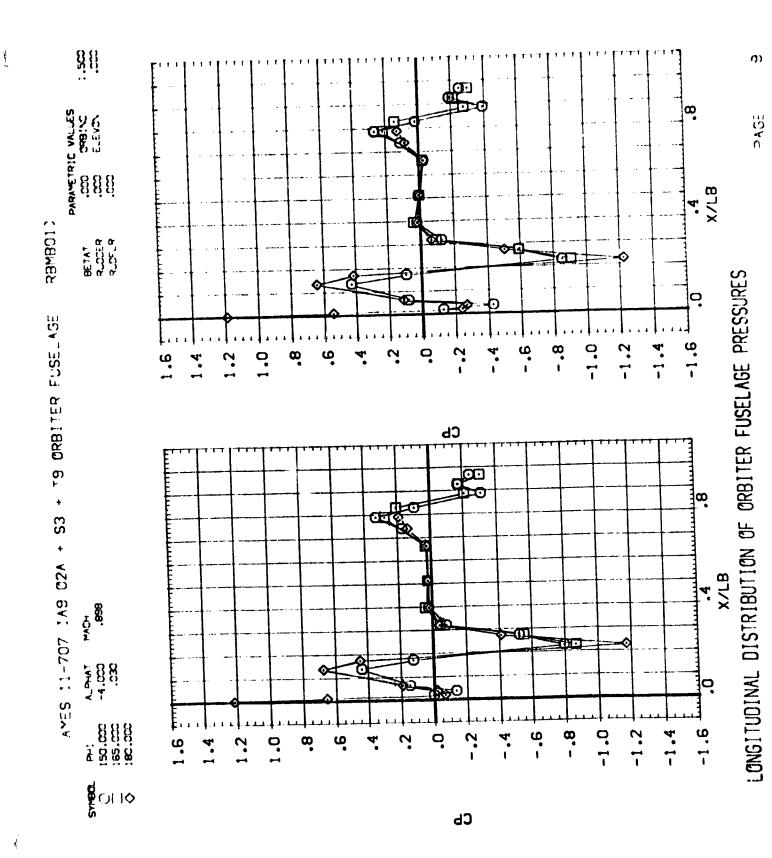






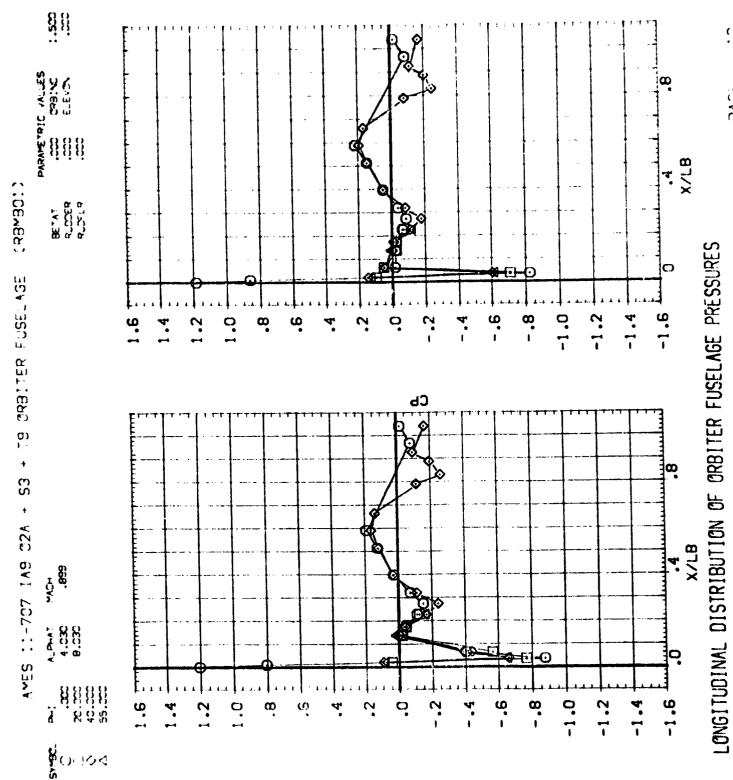


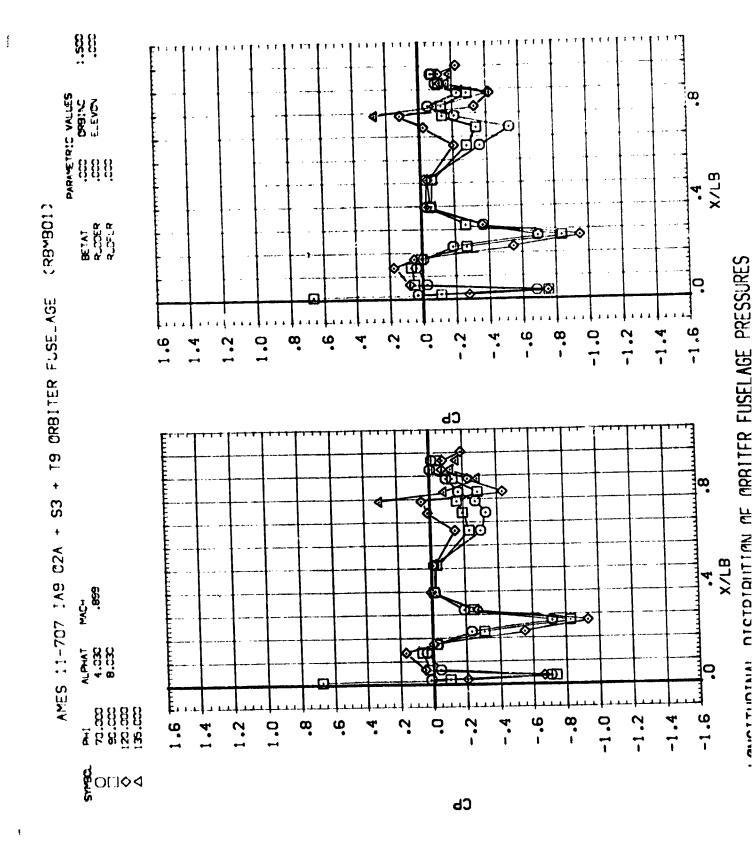


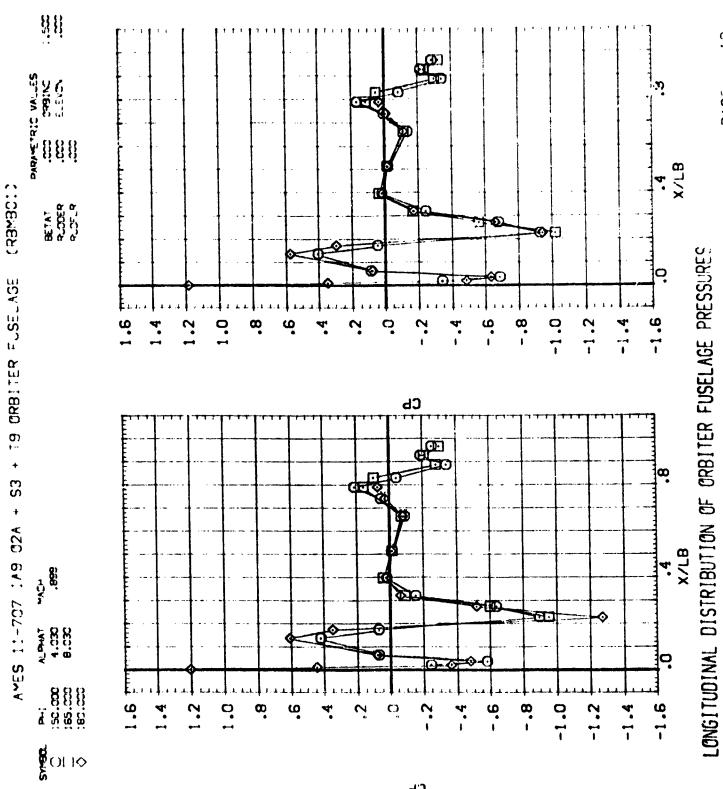






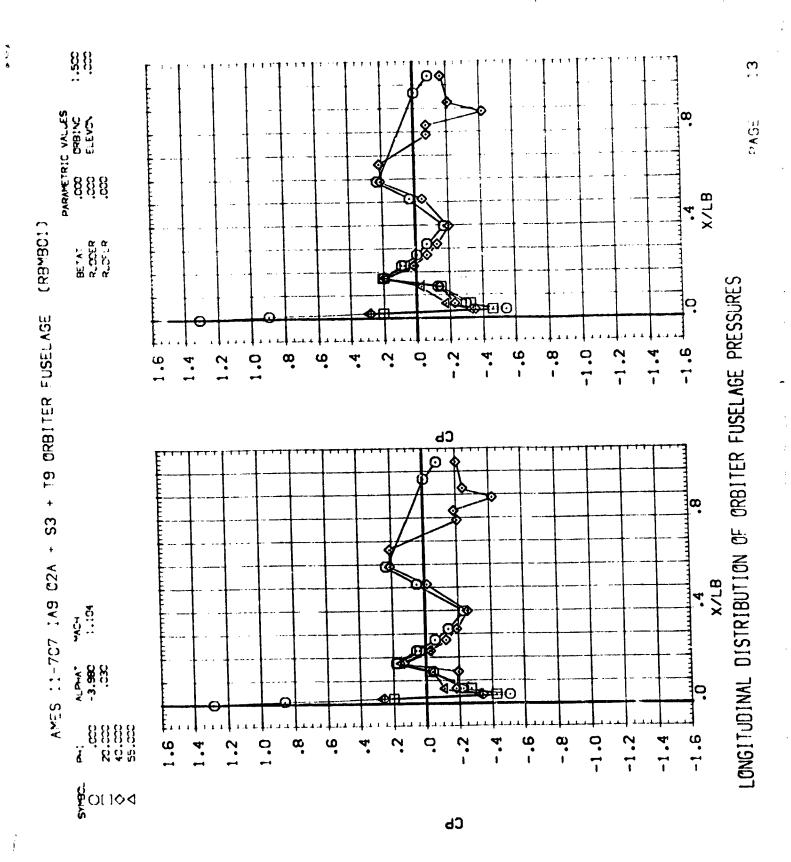


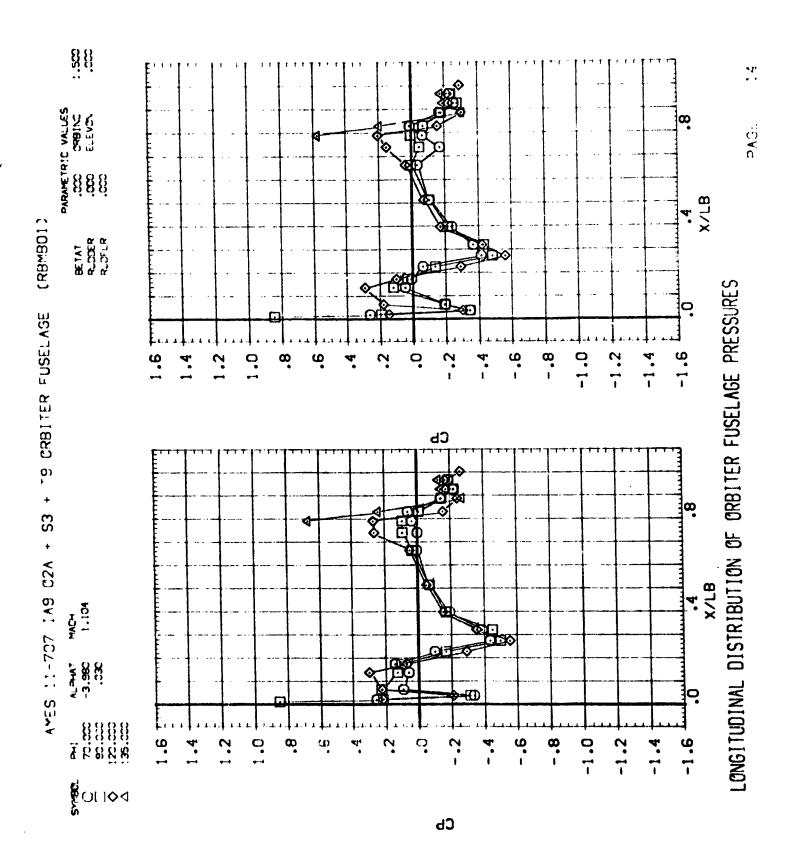




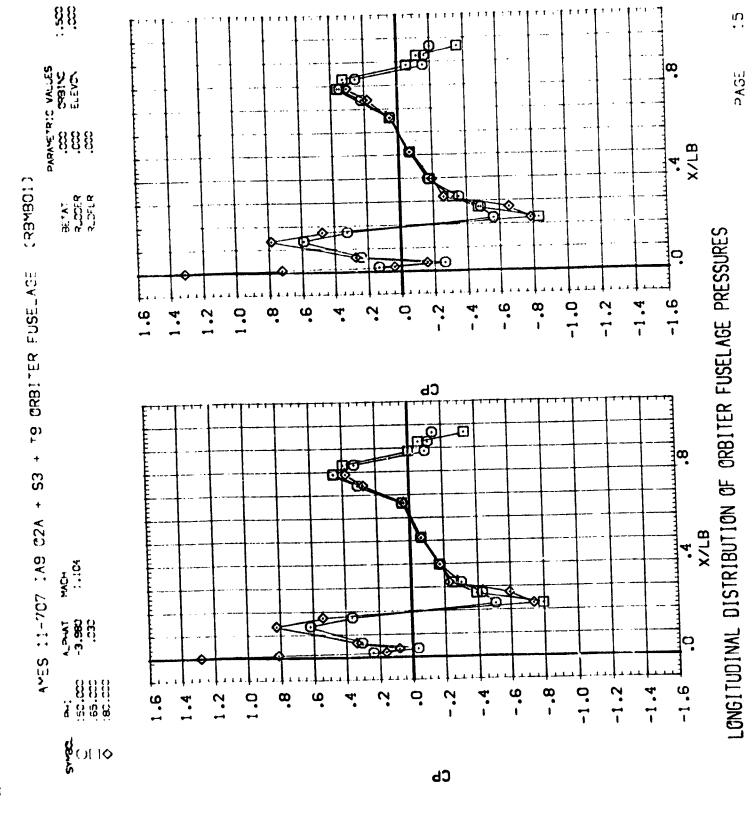
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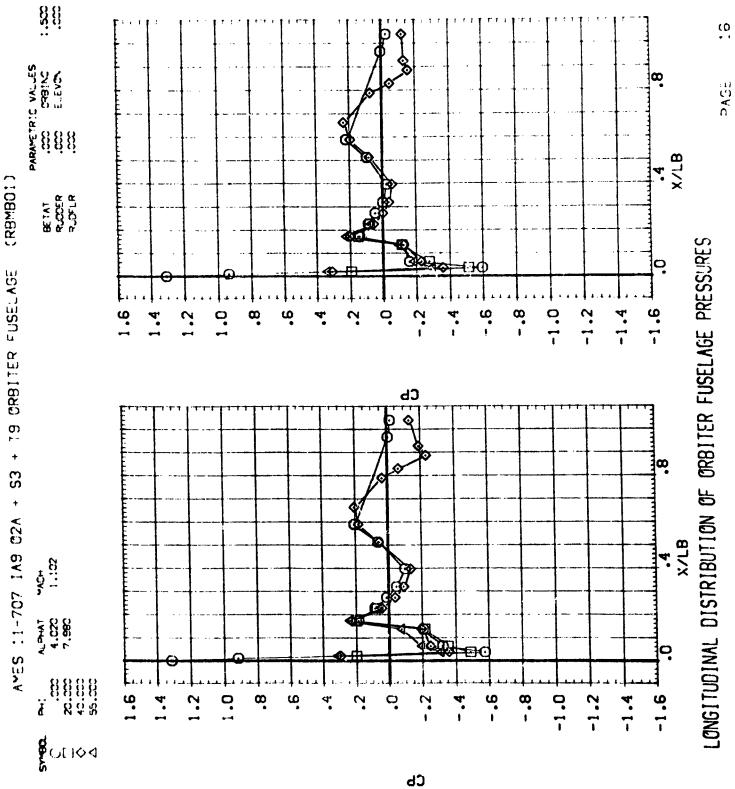
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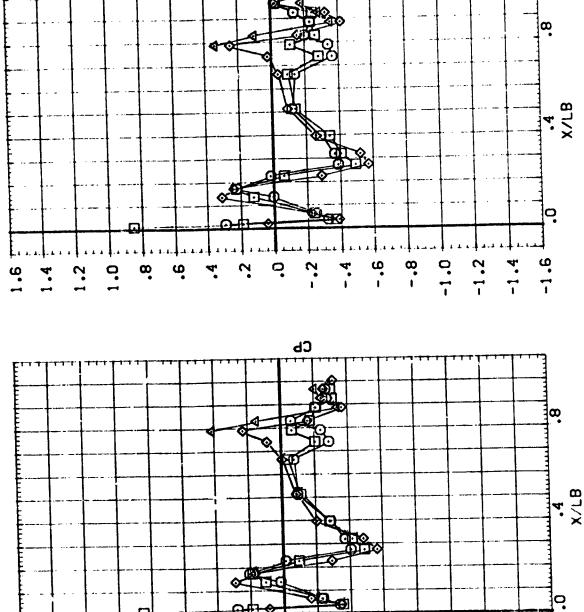








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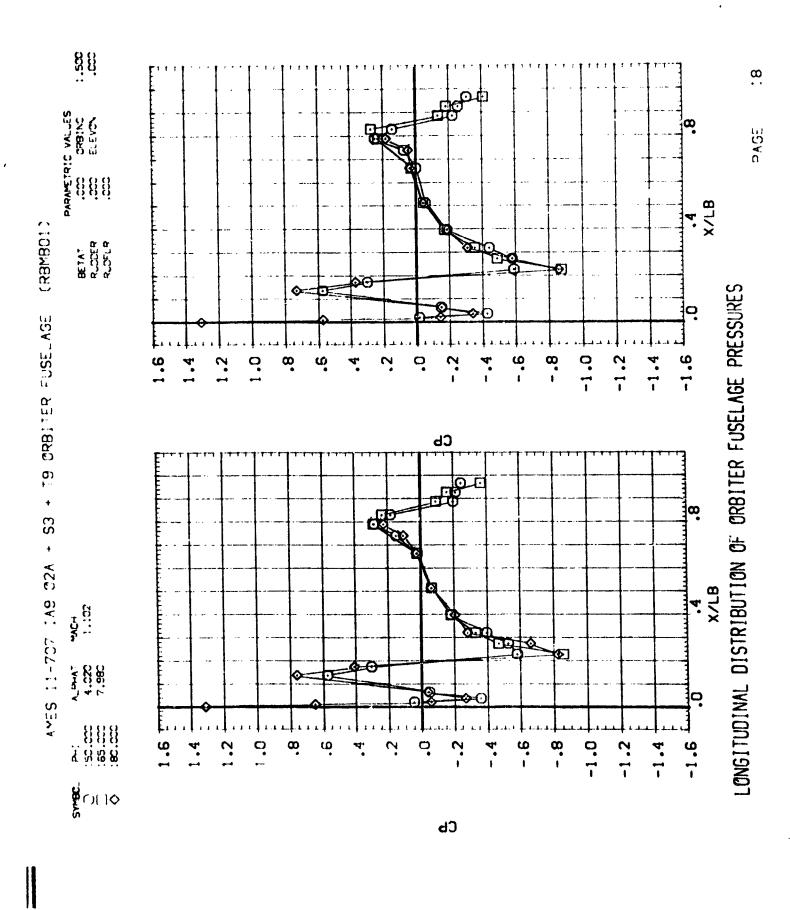
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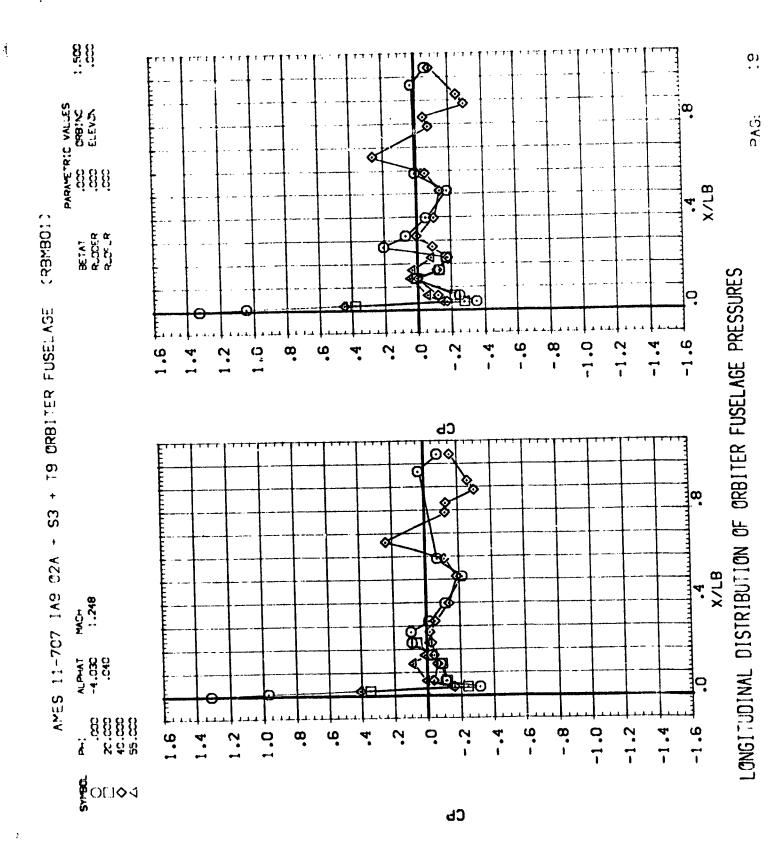
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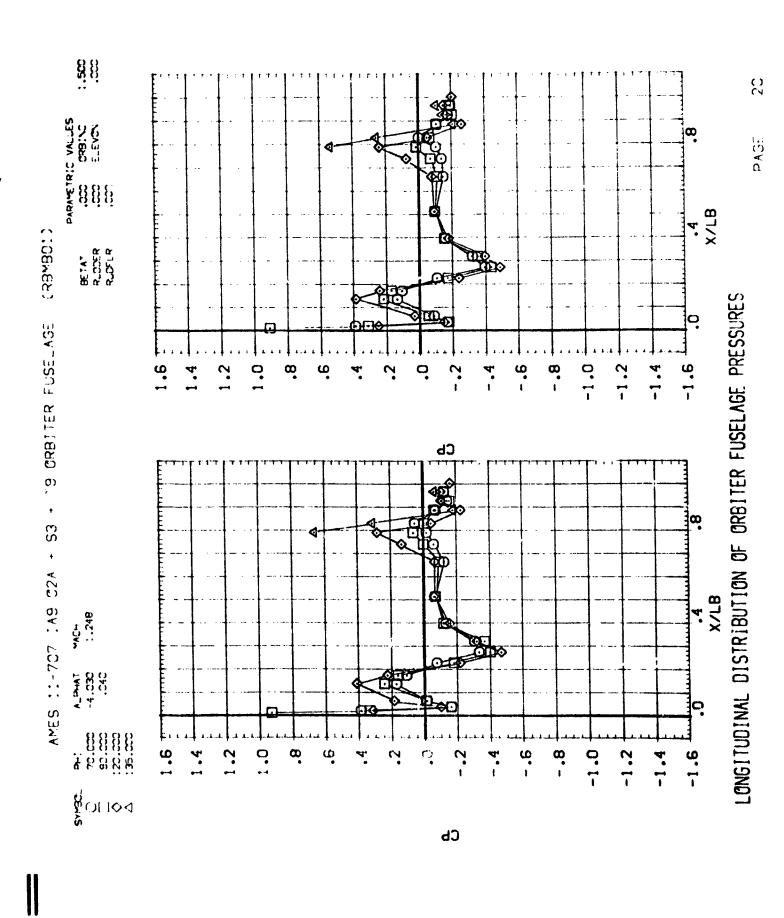
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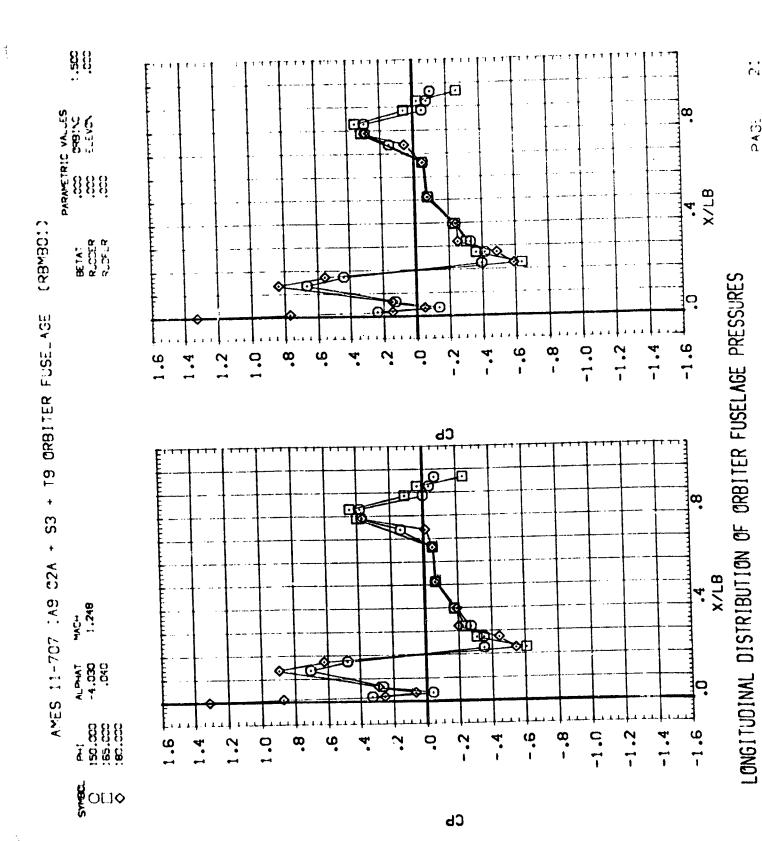
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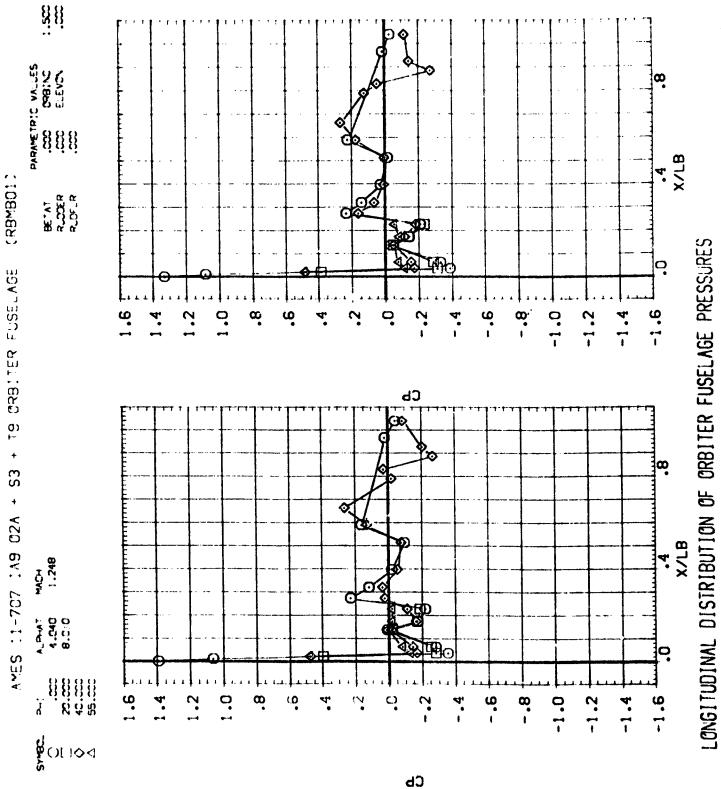


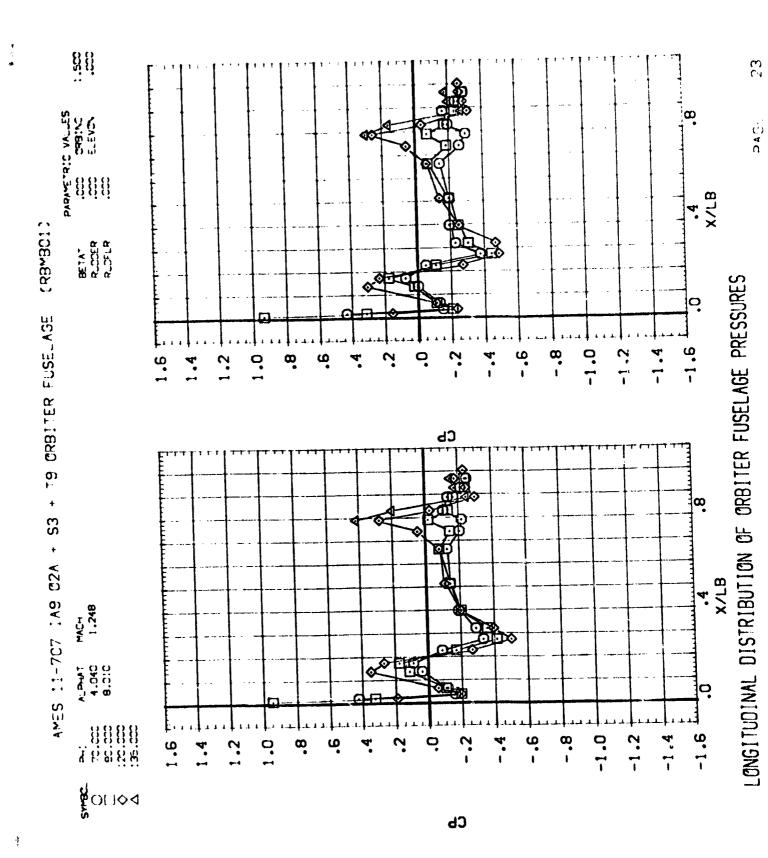




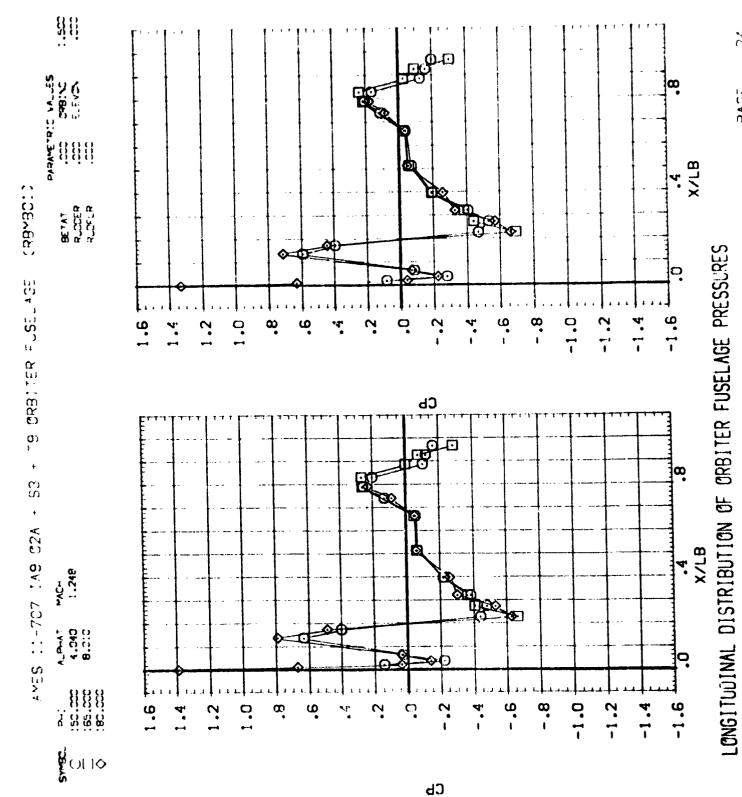


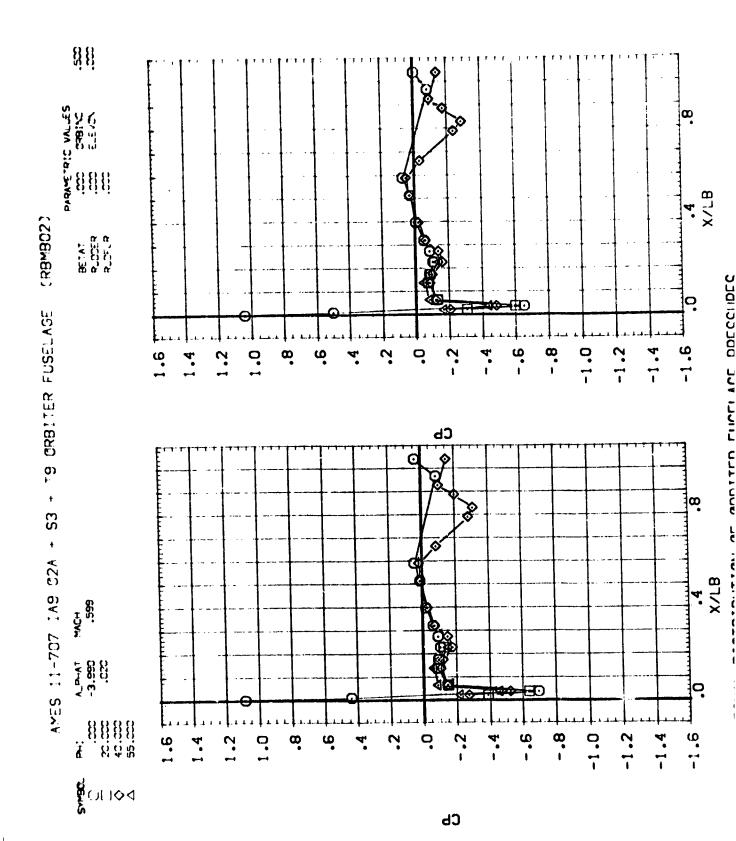








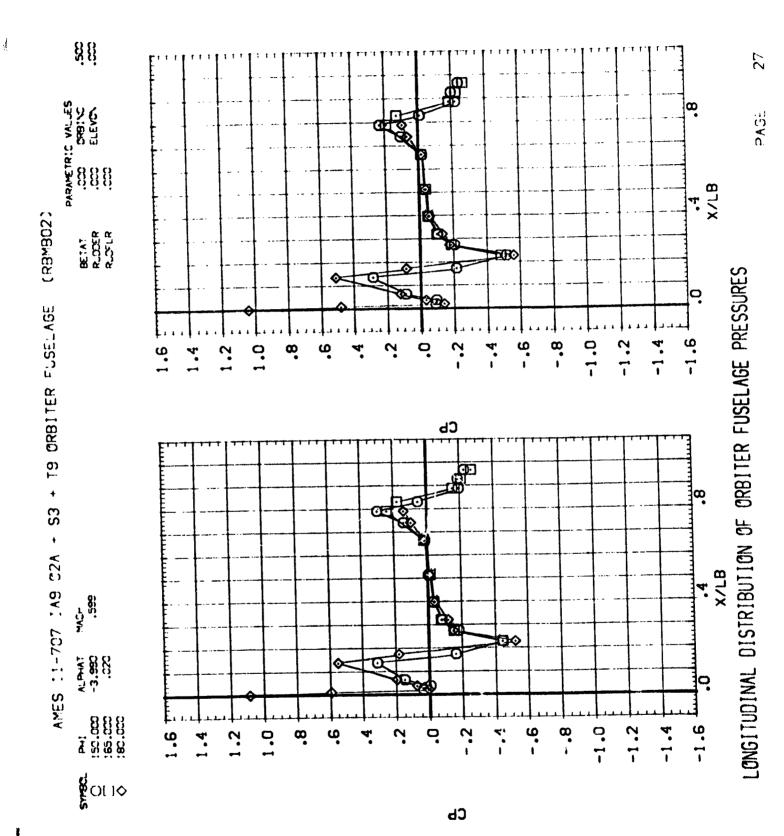




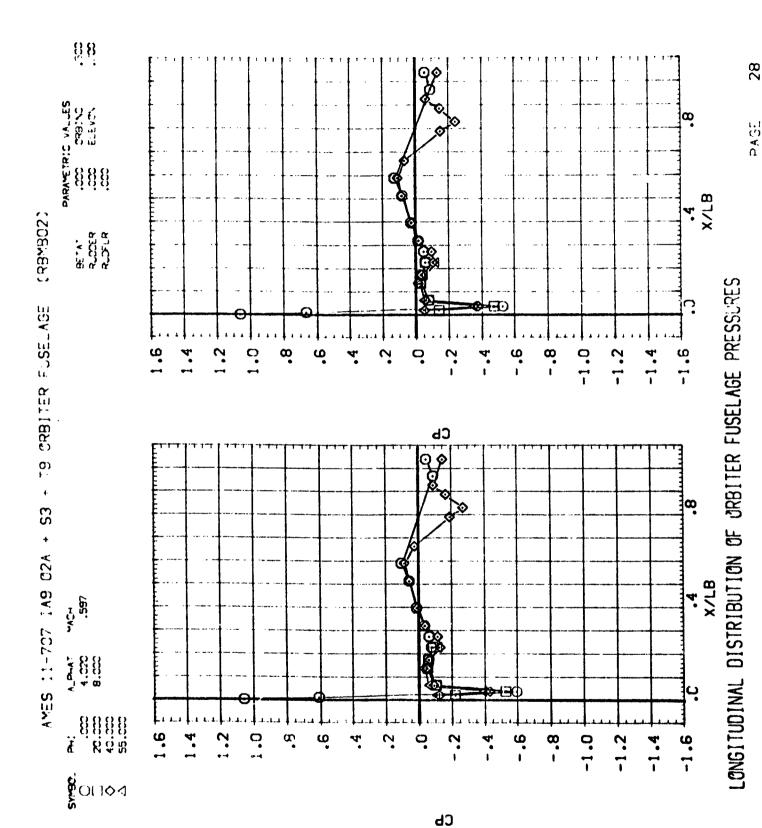


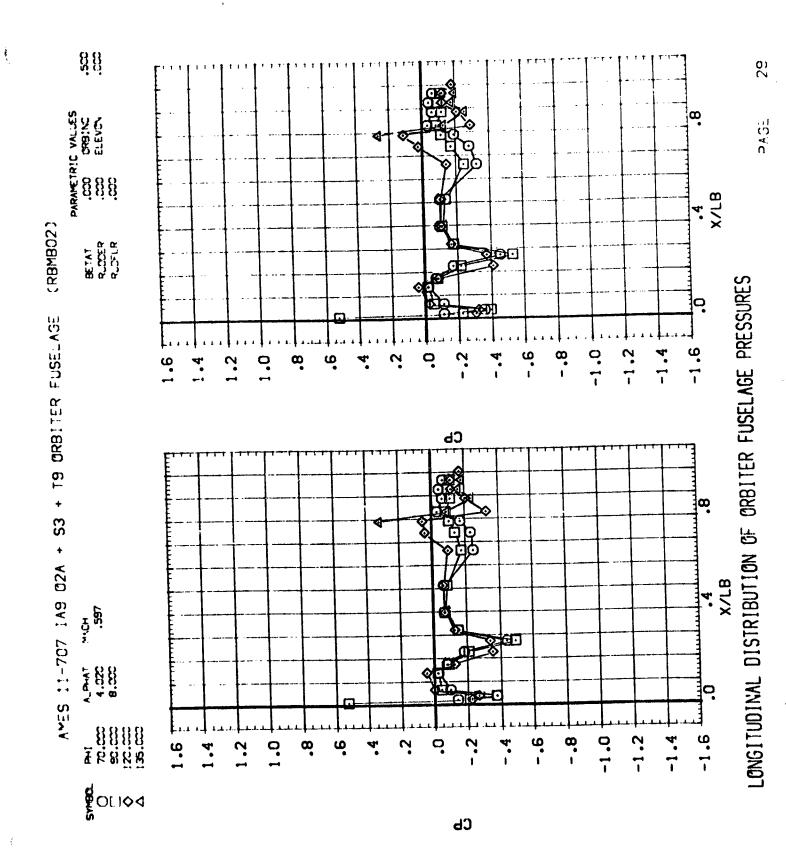
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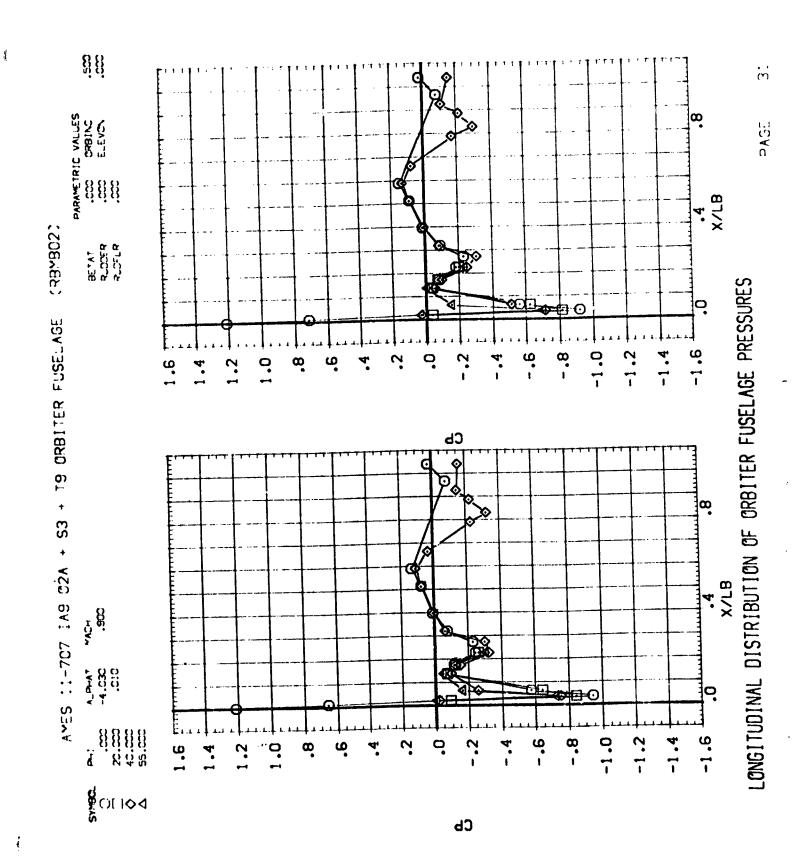
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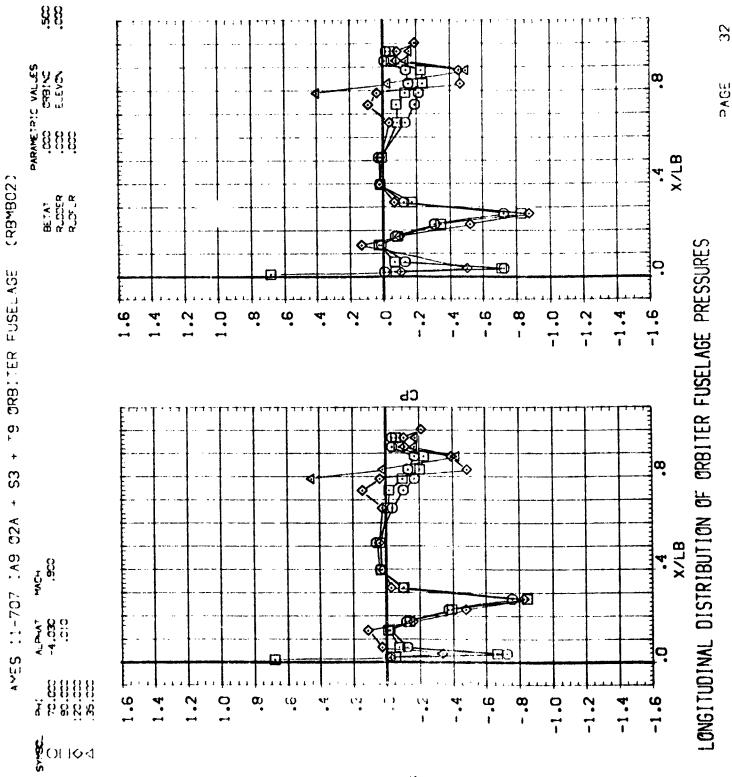
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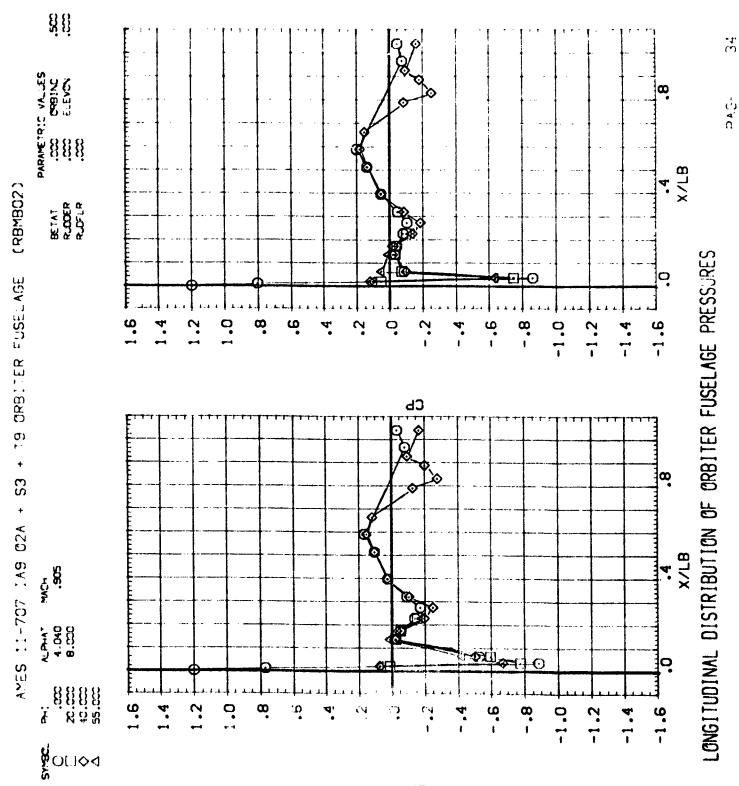
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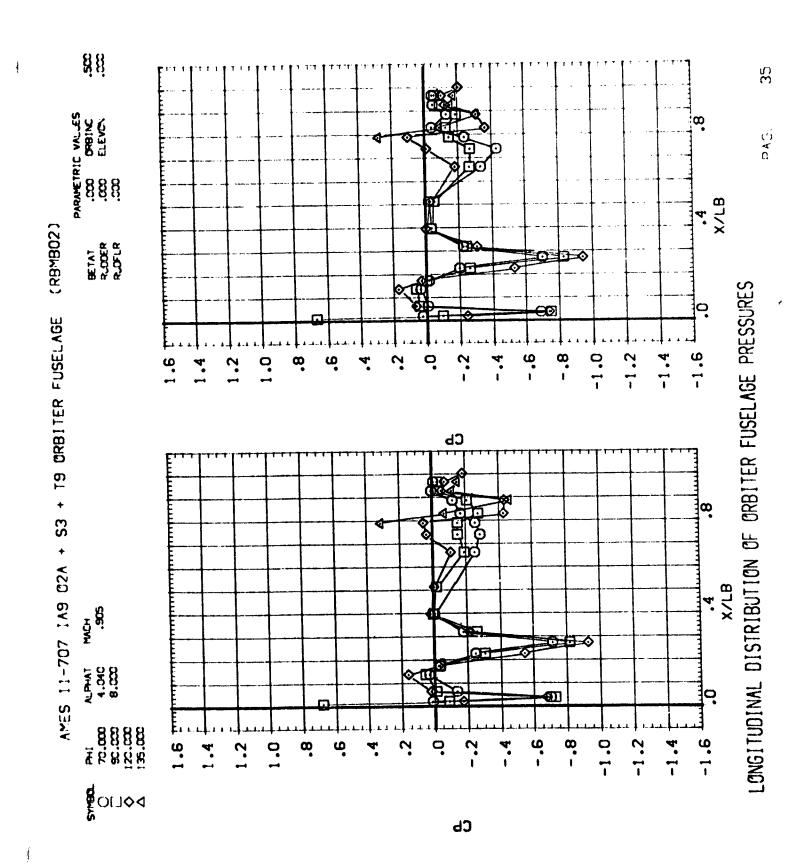
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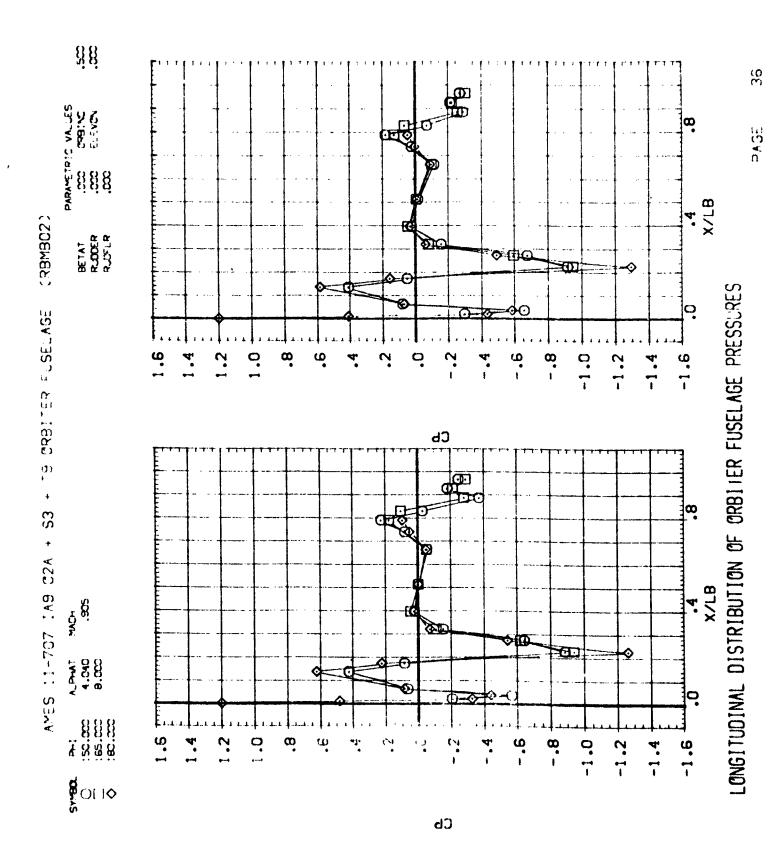
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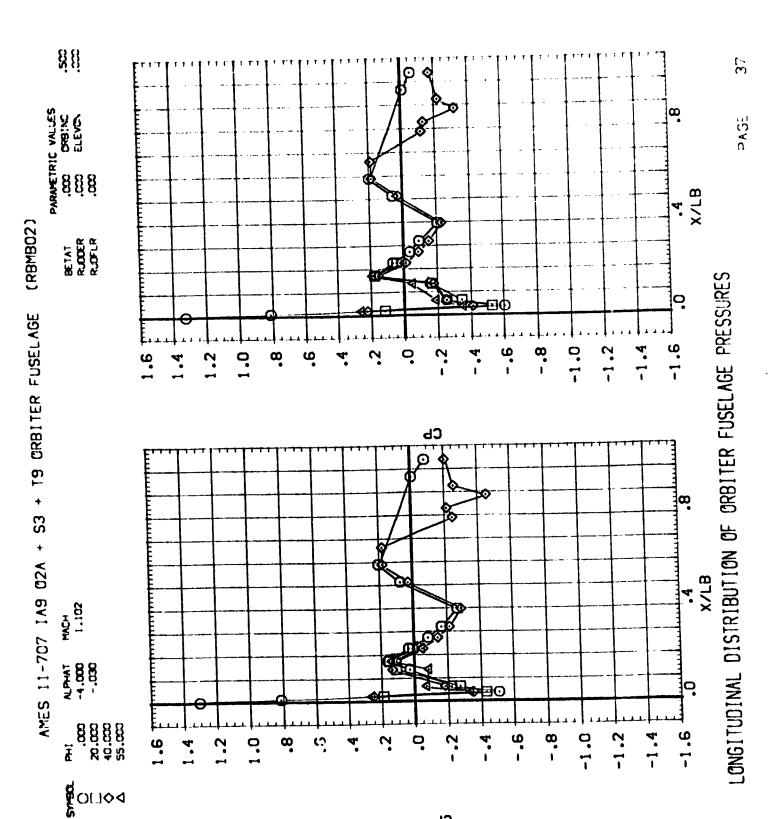
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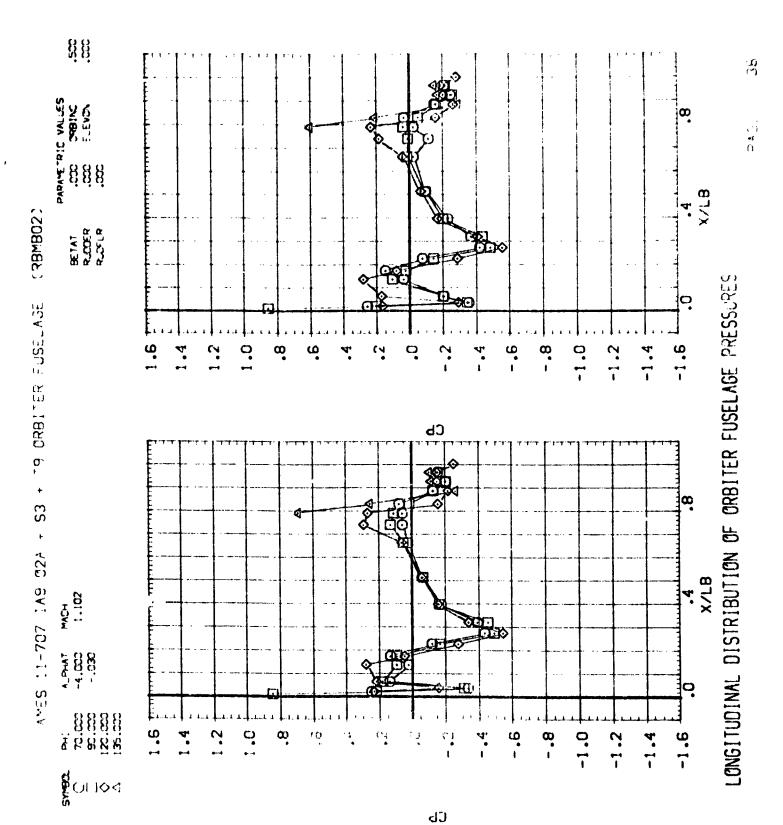






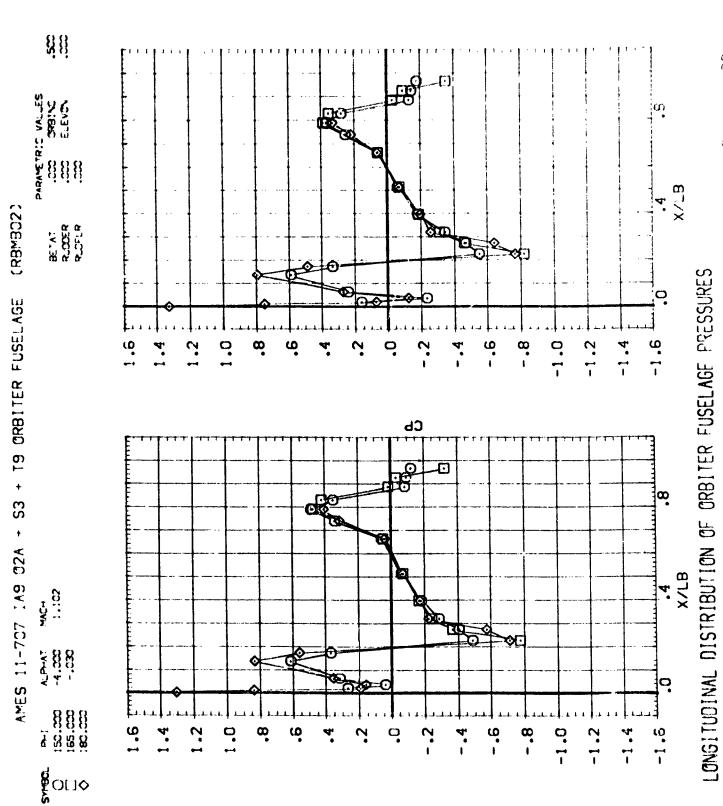
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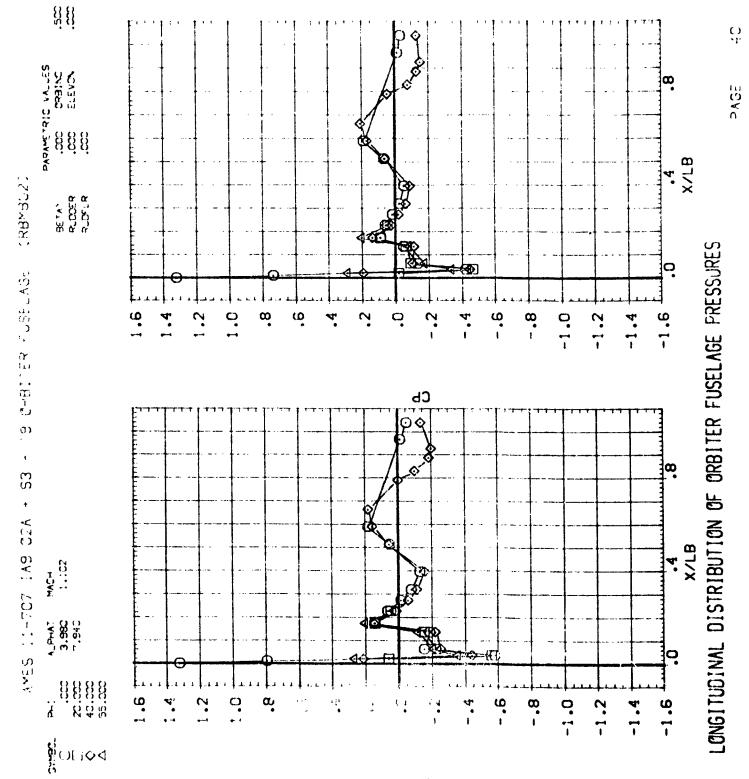
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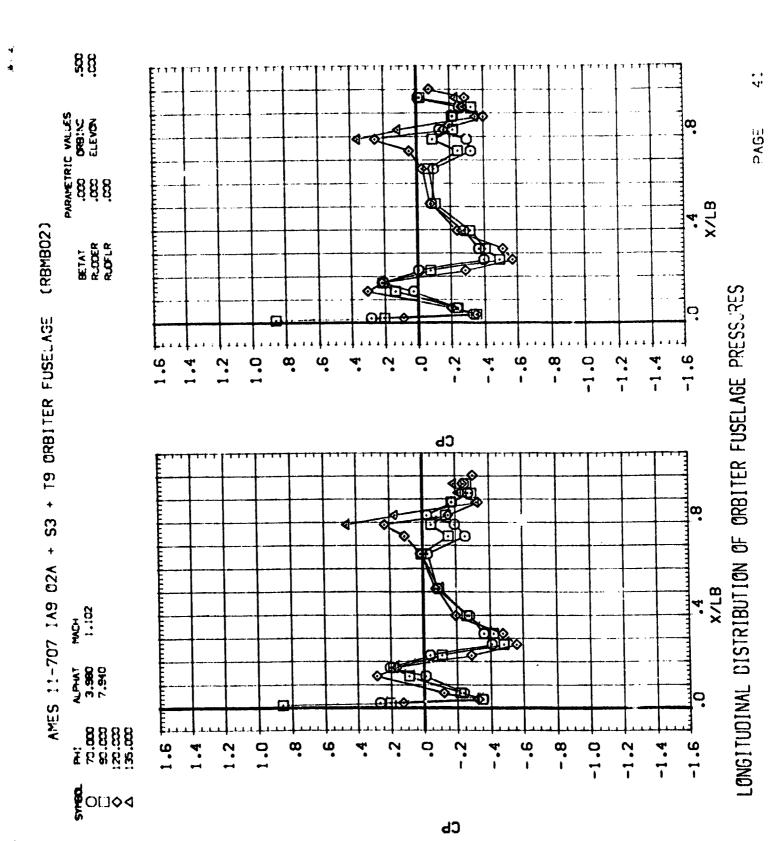




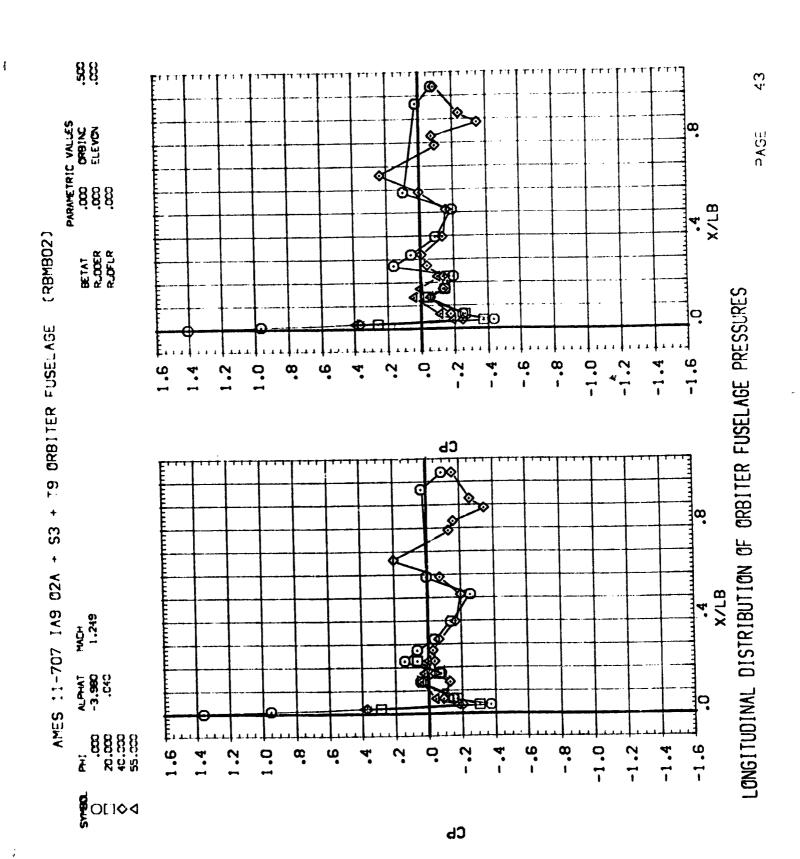
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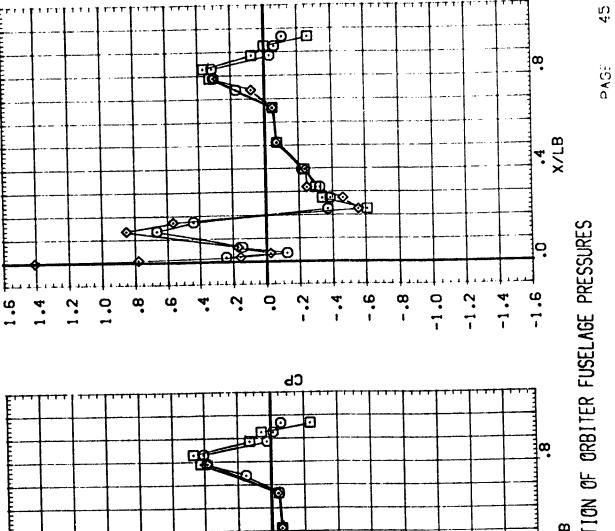
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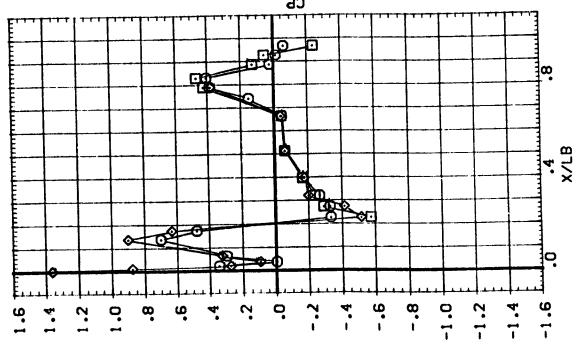


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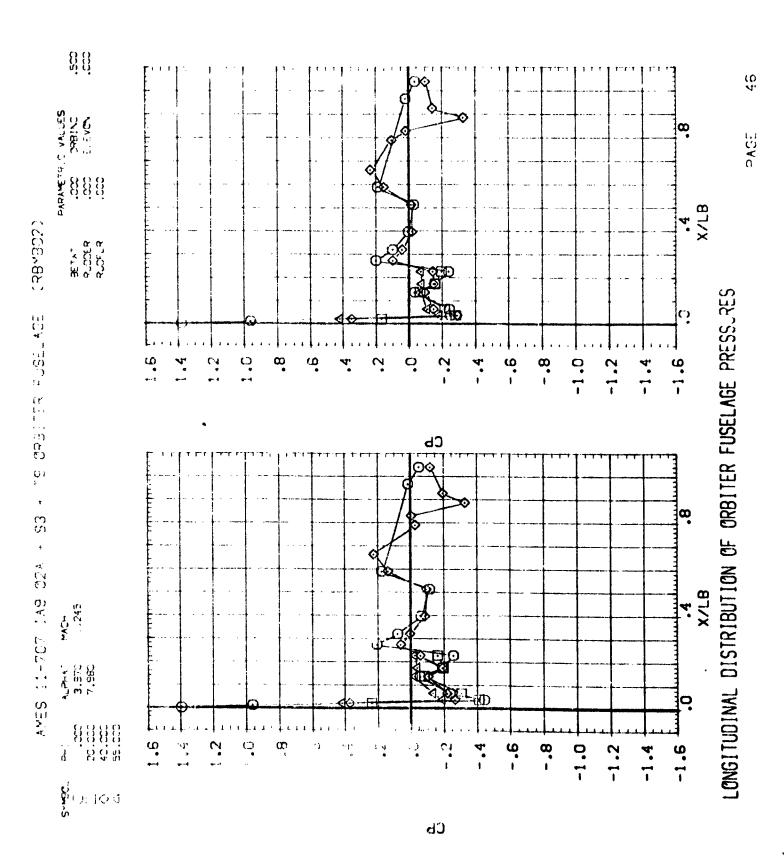
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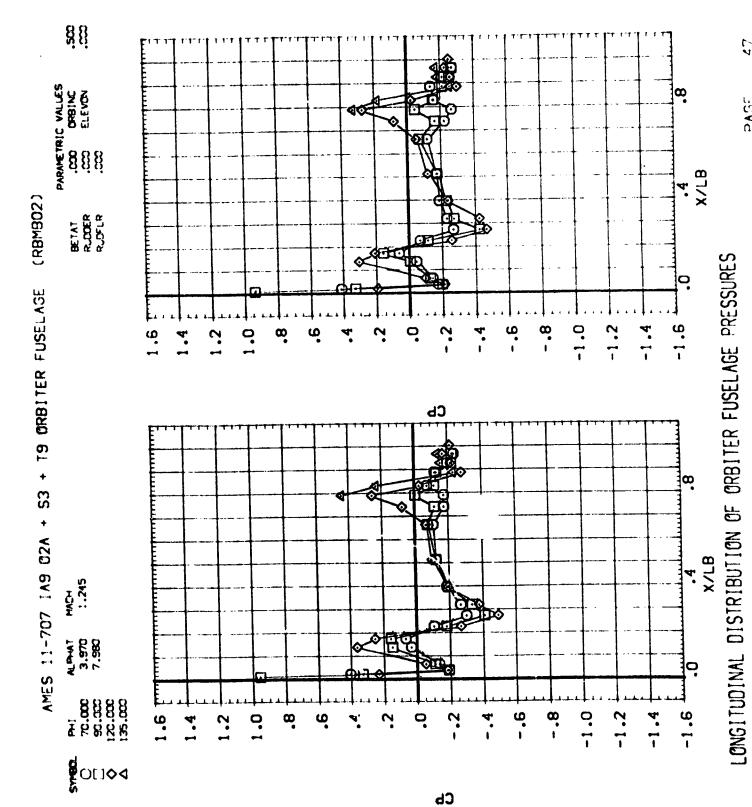
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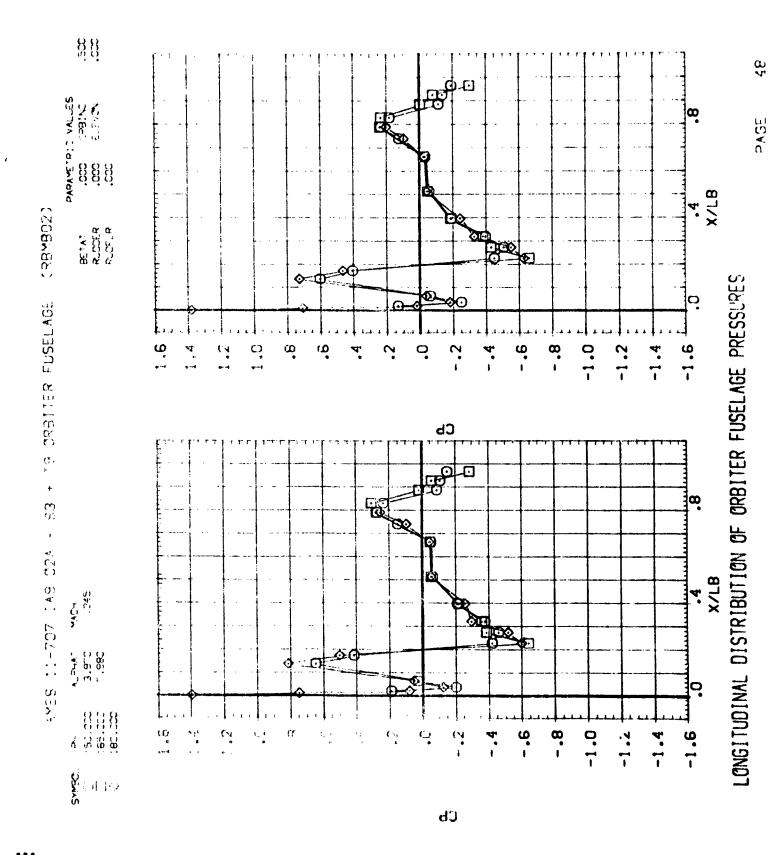
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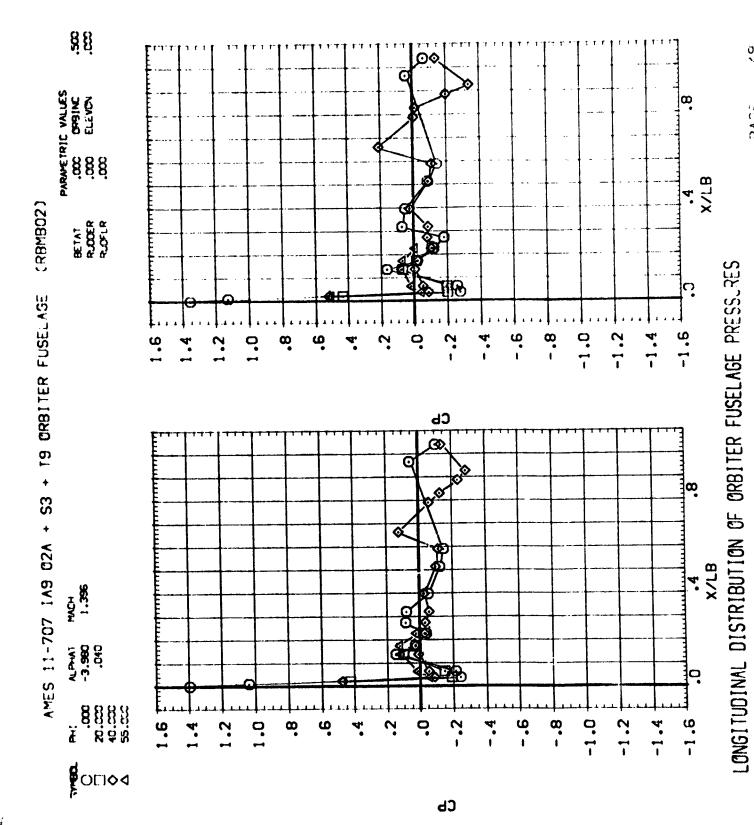
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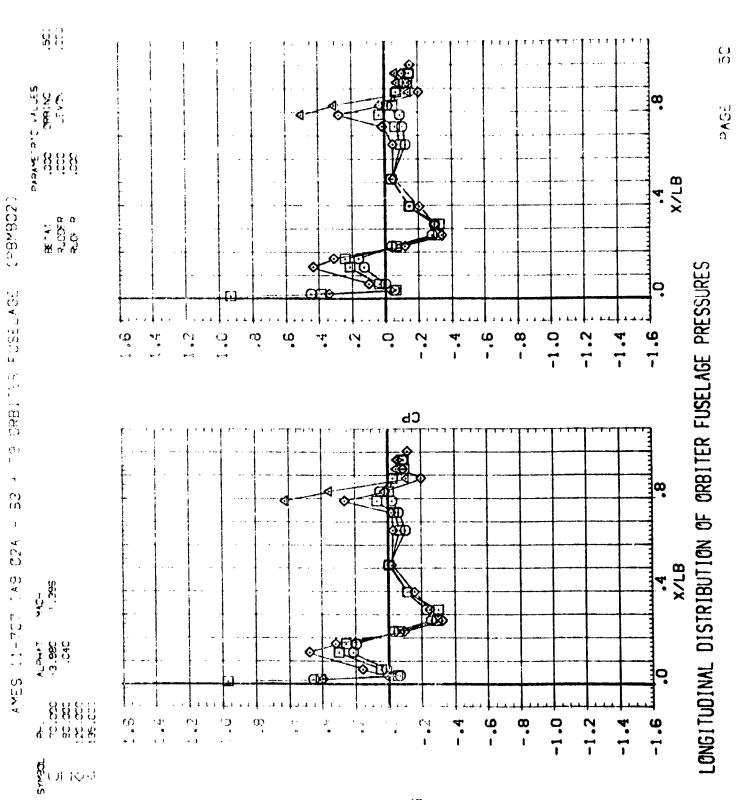




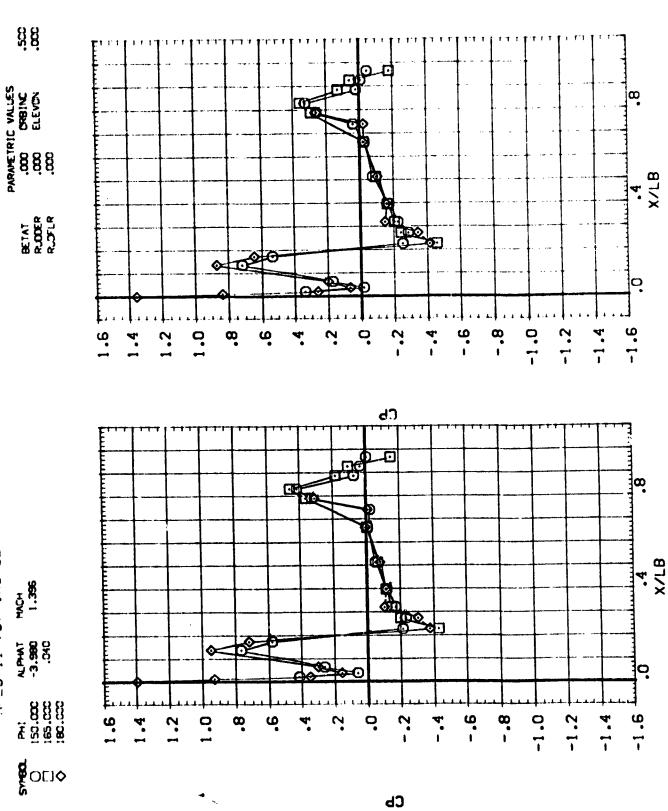








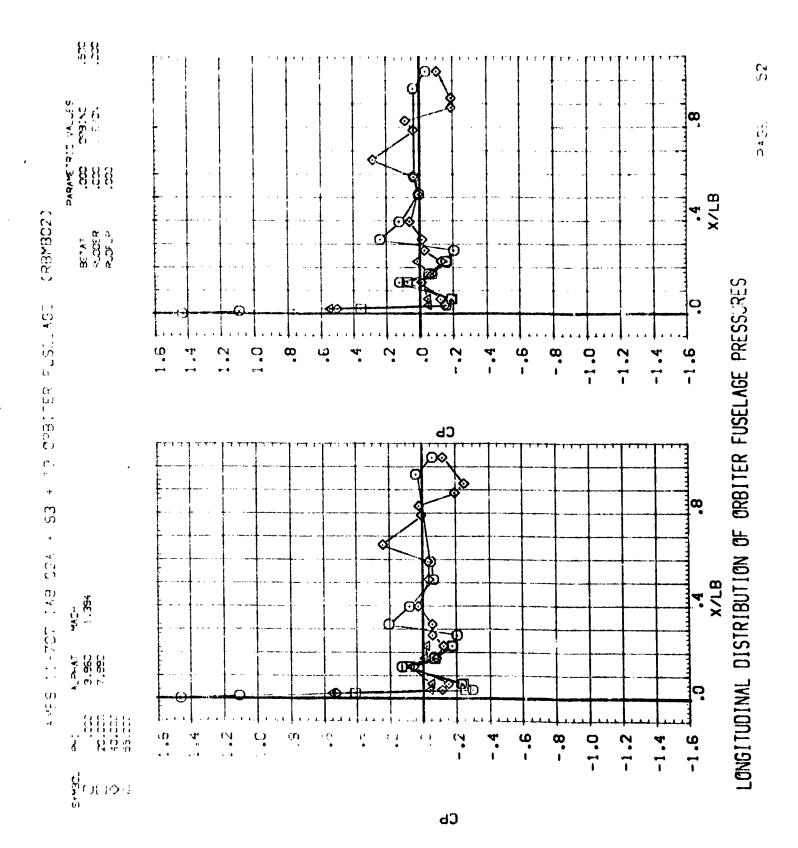


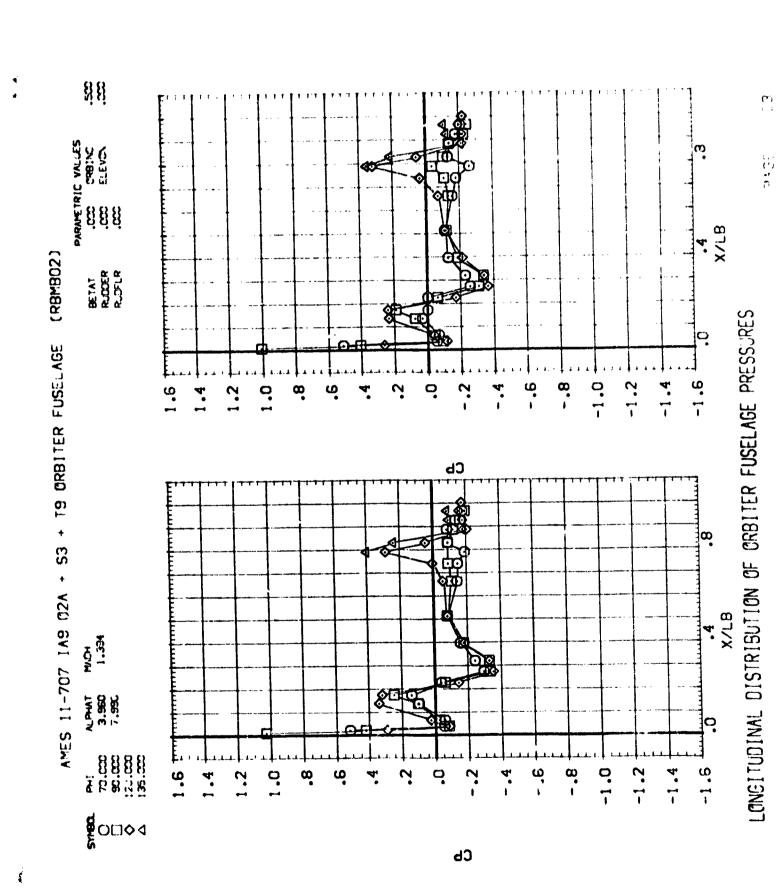


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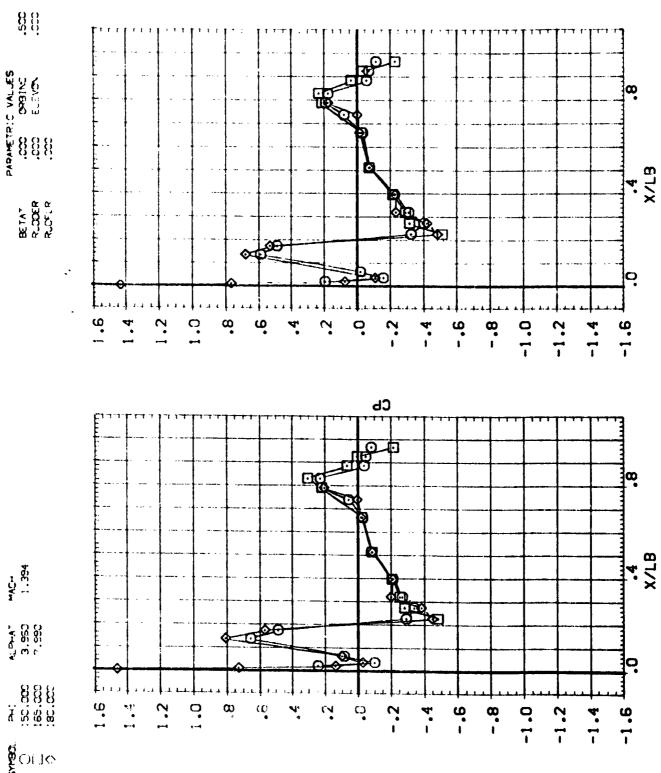
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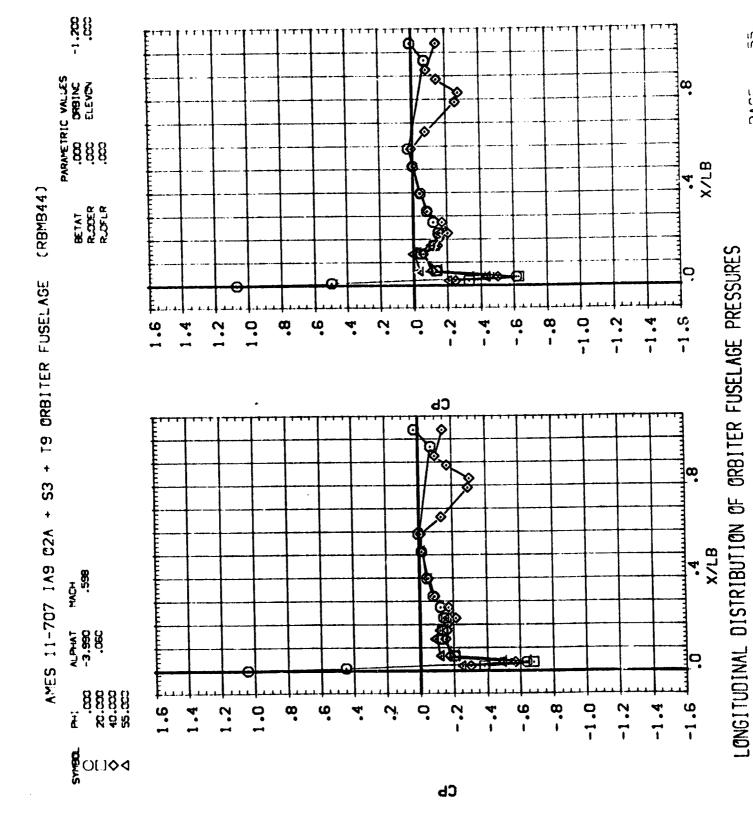


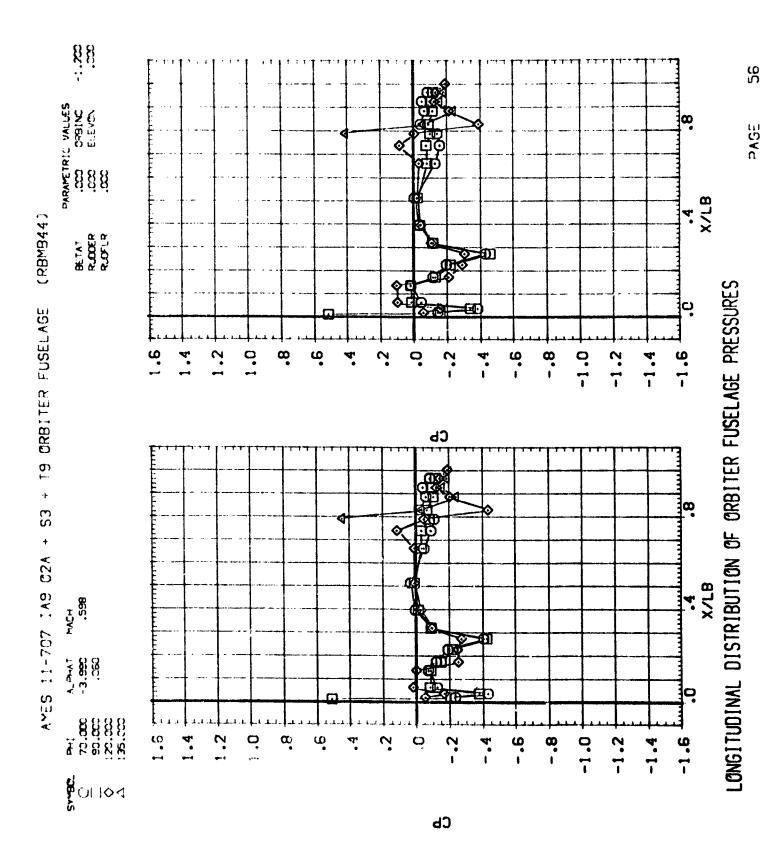
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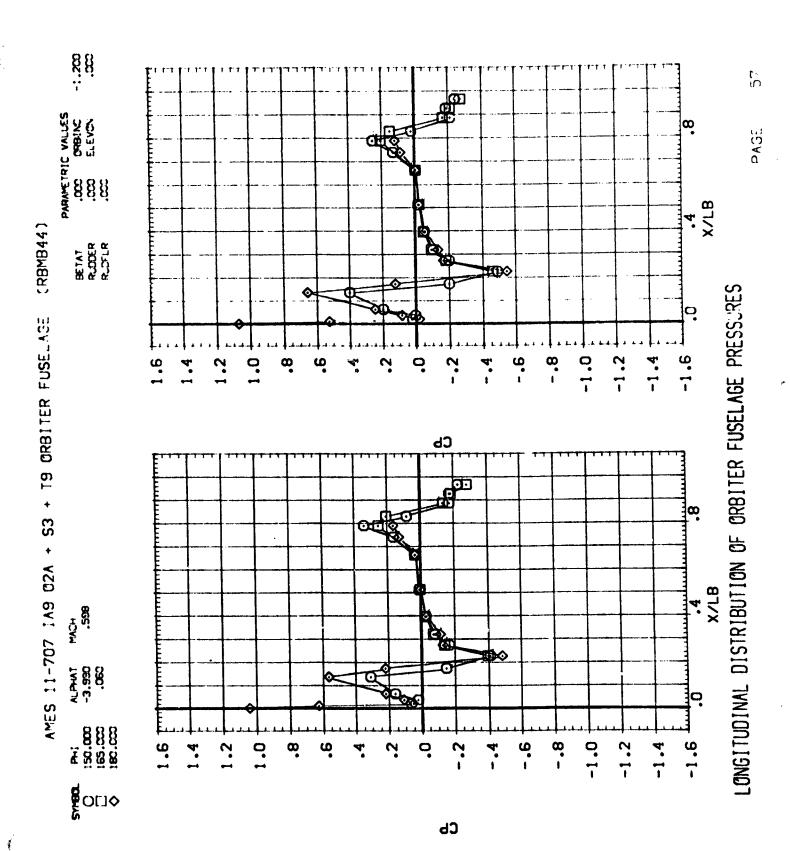


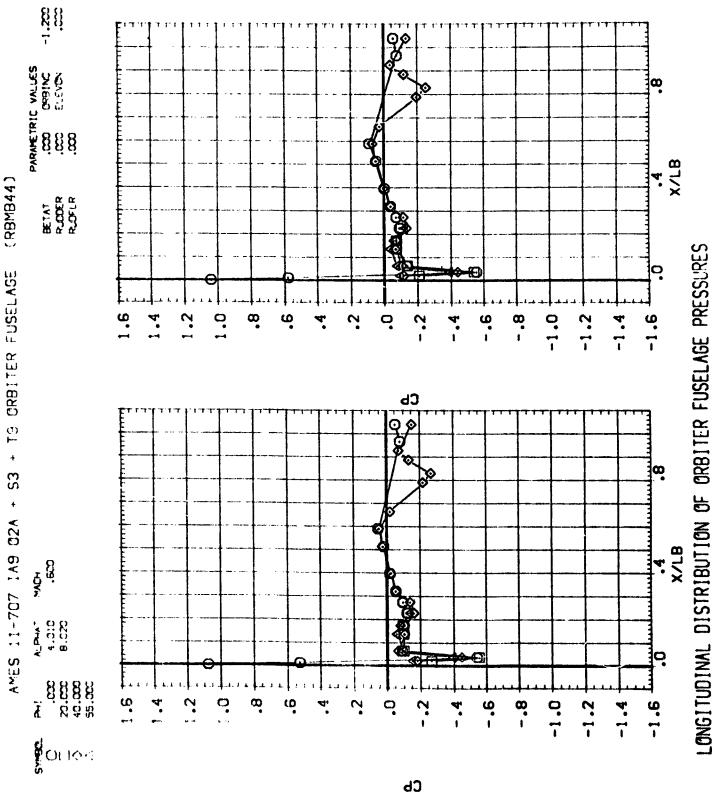
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LONGITUDINAL DISTRIBUTION OF ORBITER FUSELAGE PRESSURES



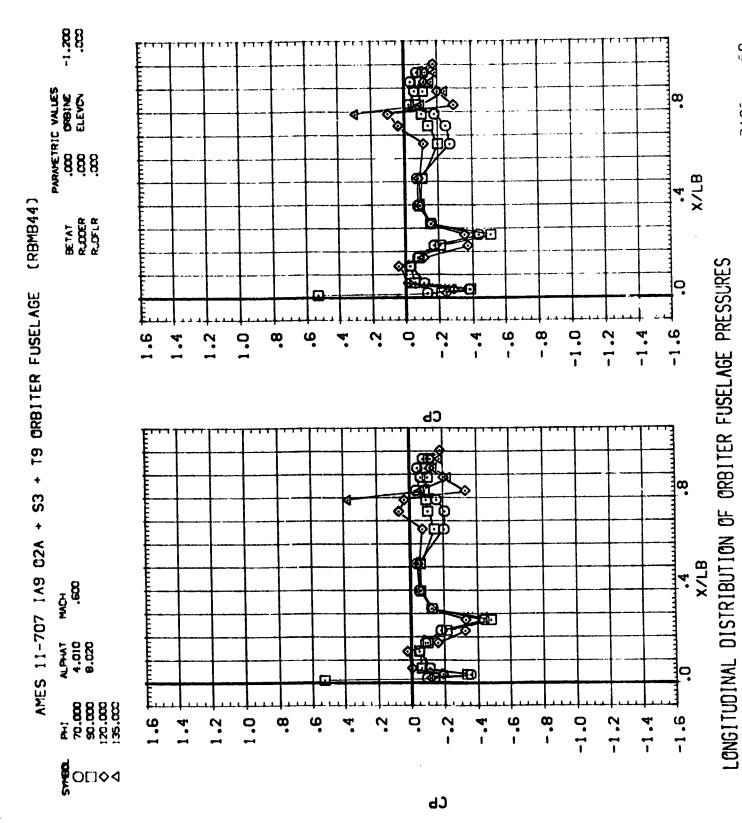


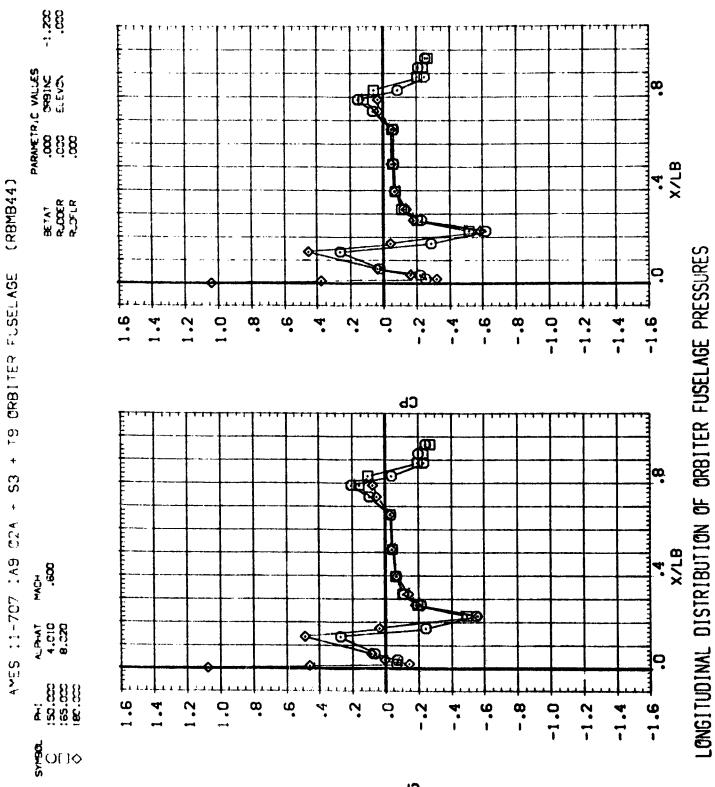




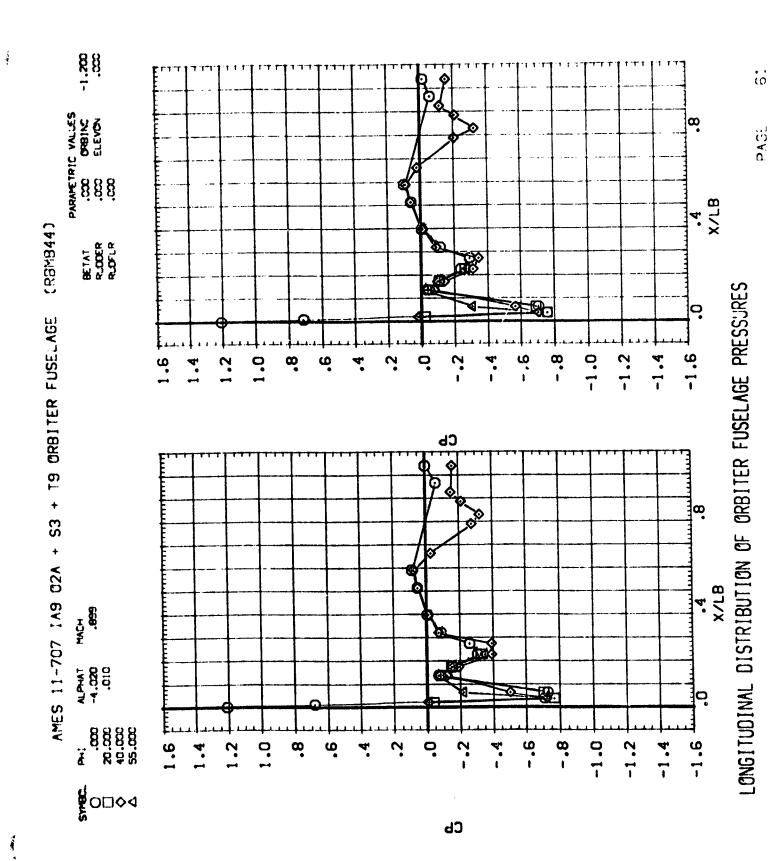
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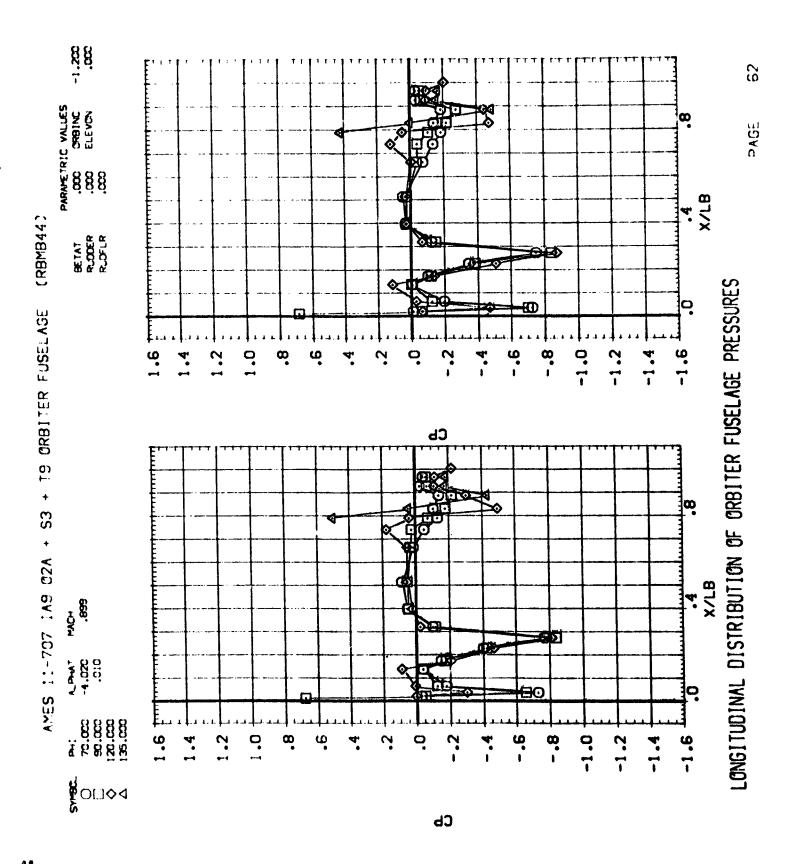






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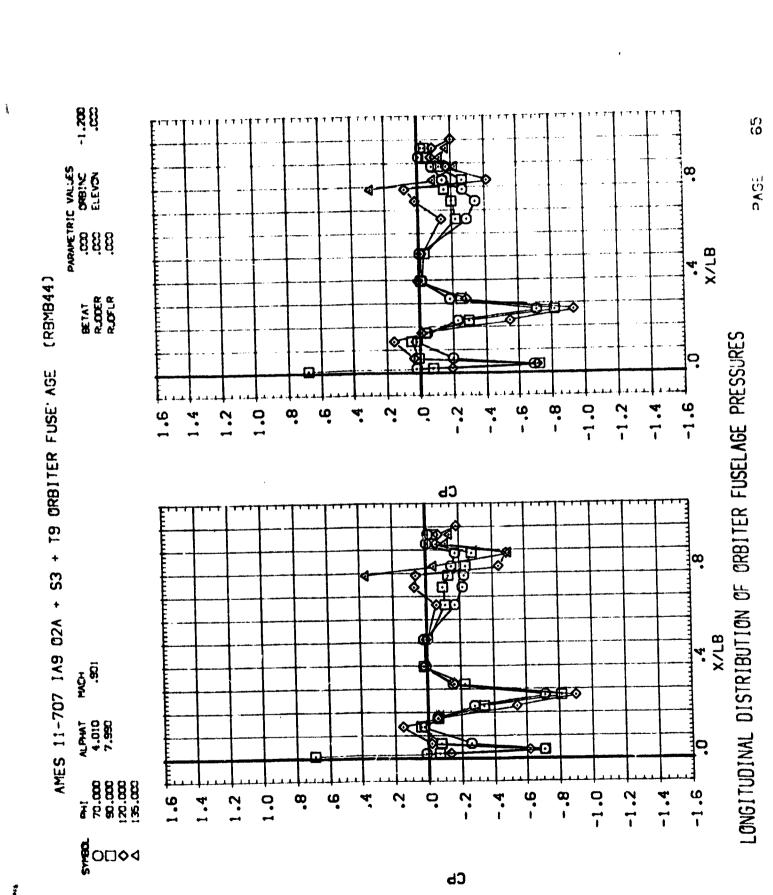


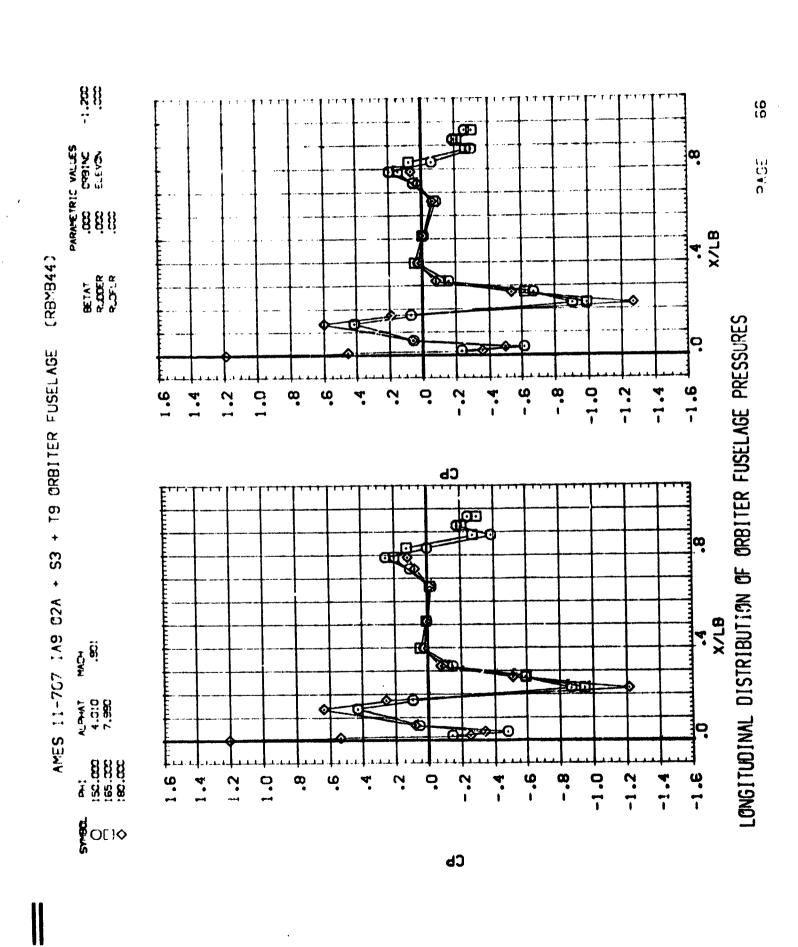
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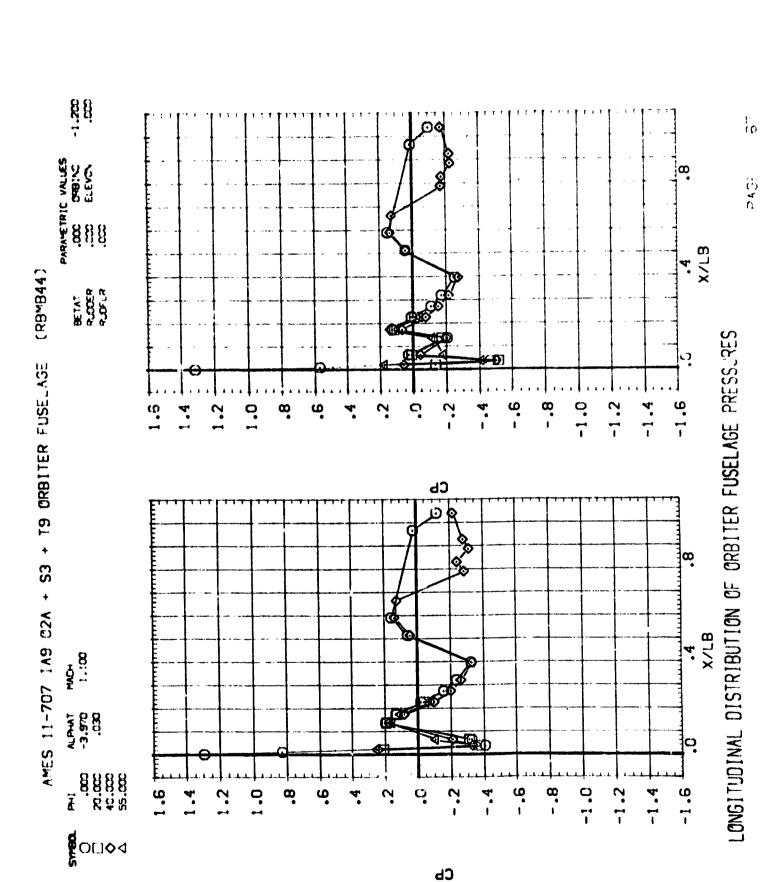
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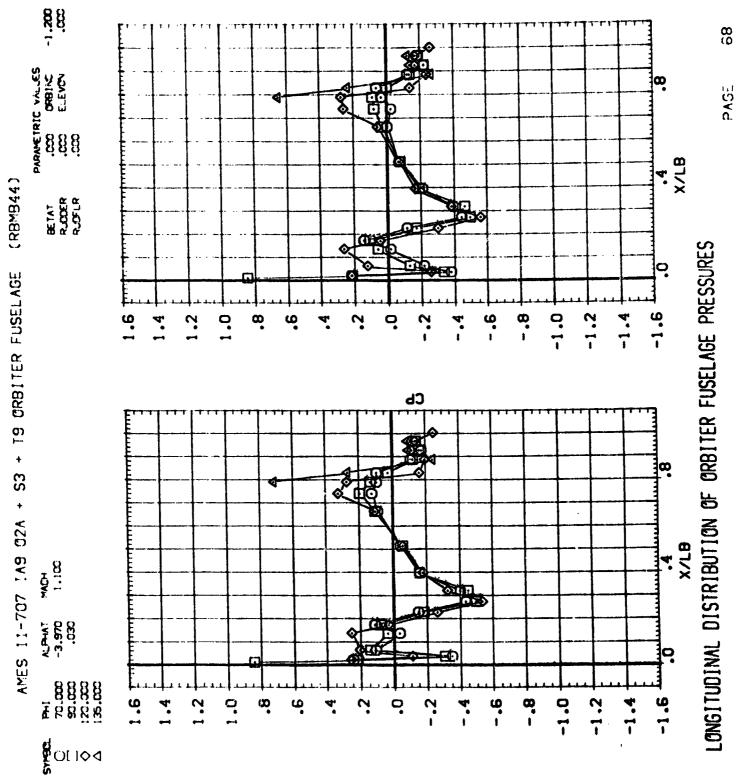


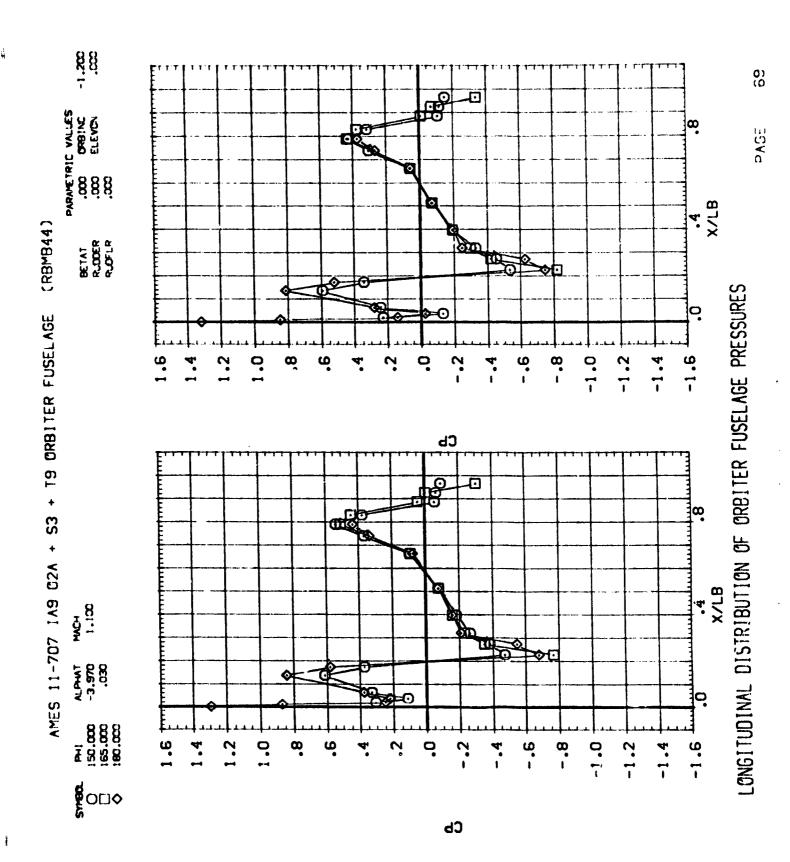


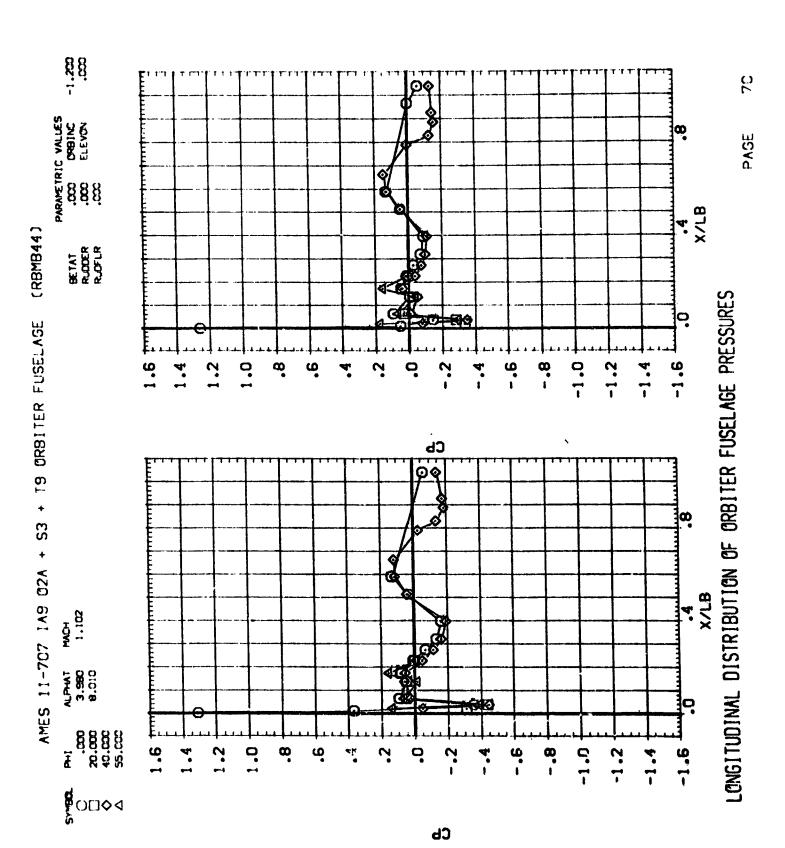




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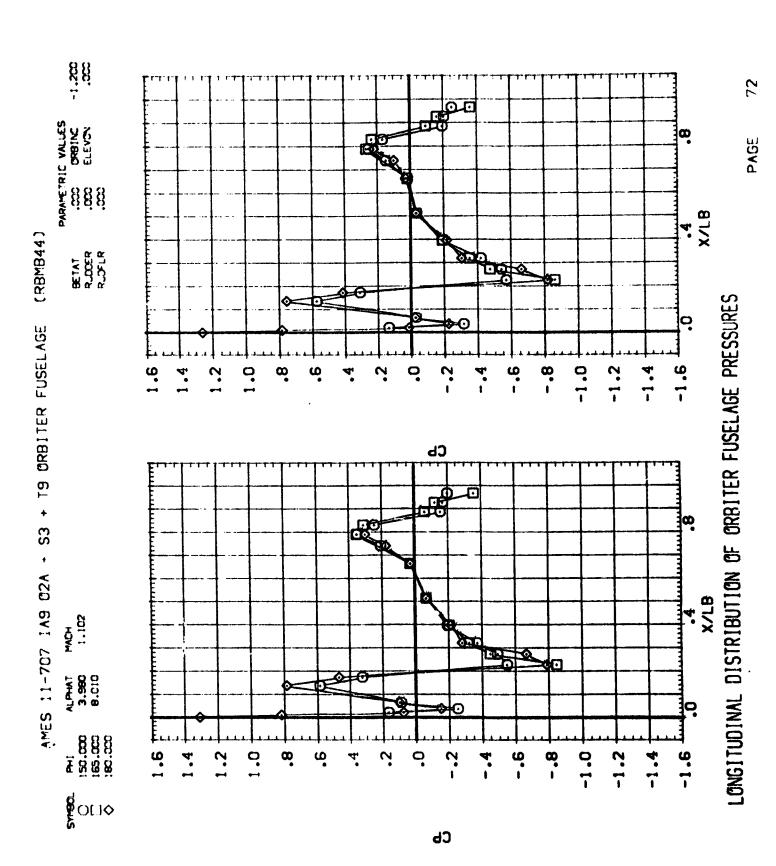


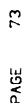


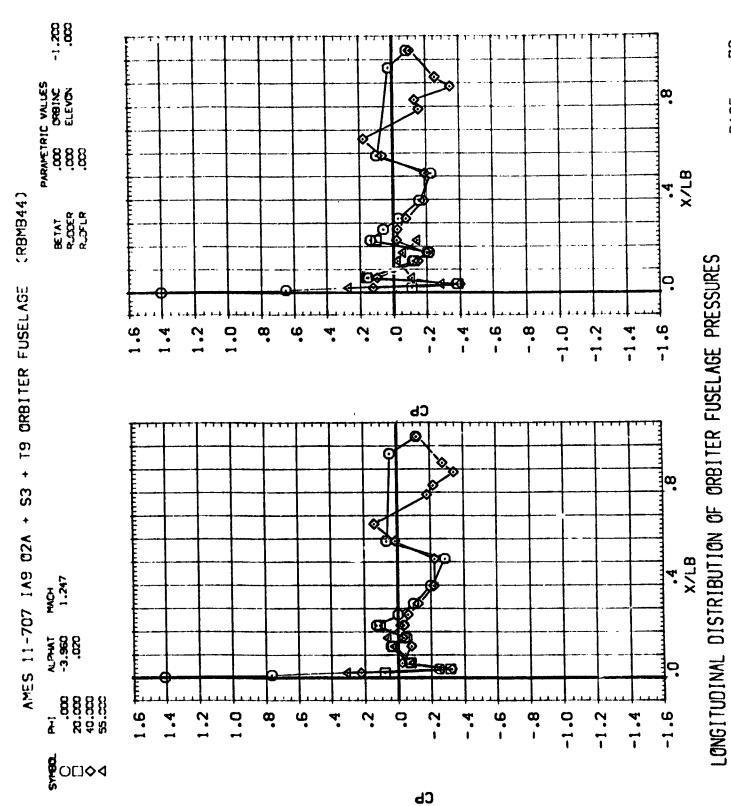


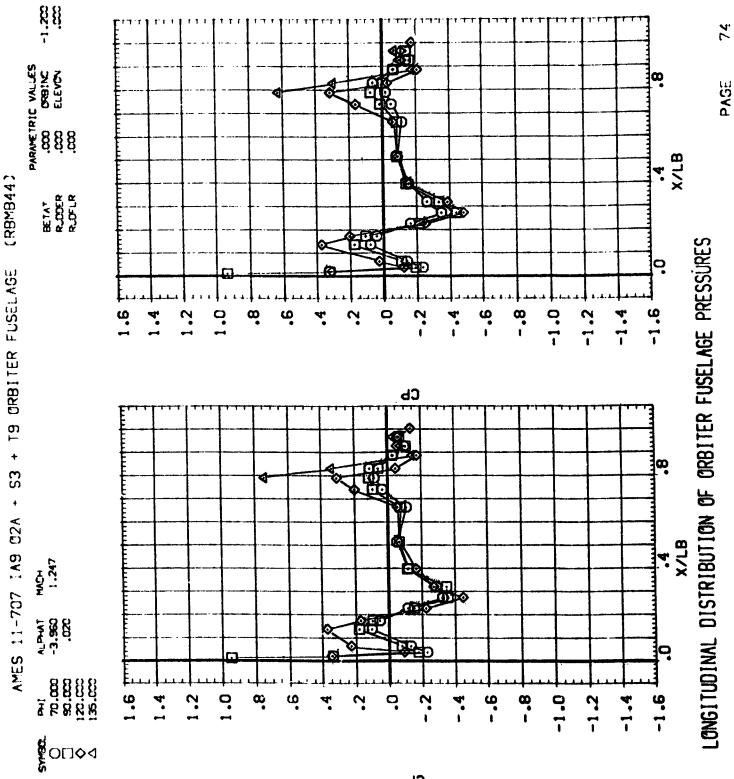
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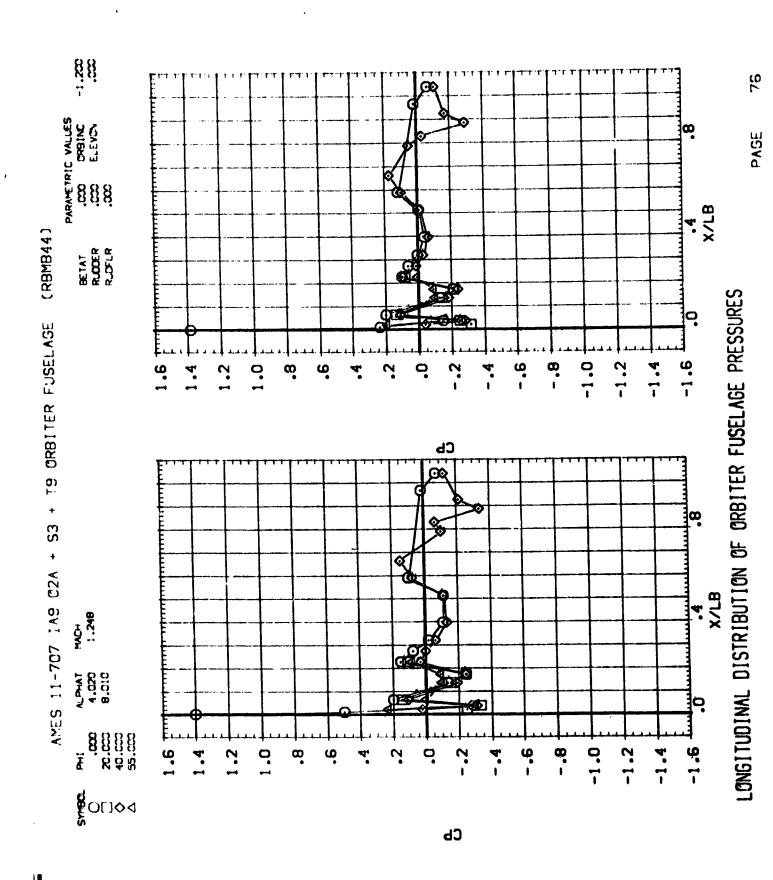


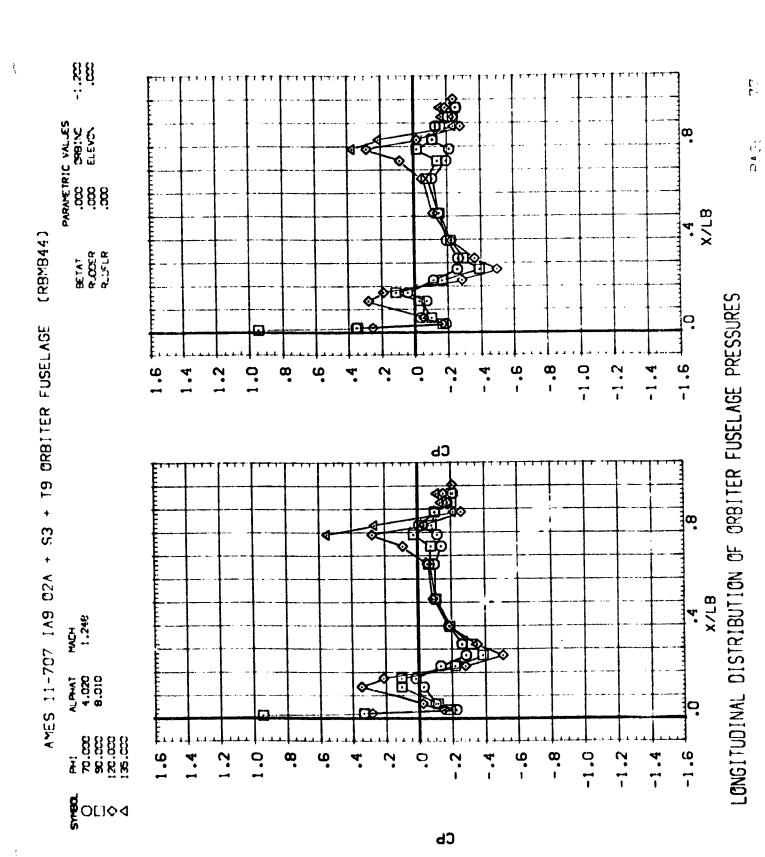


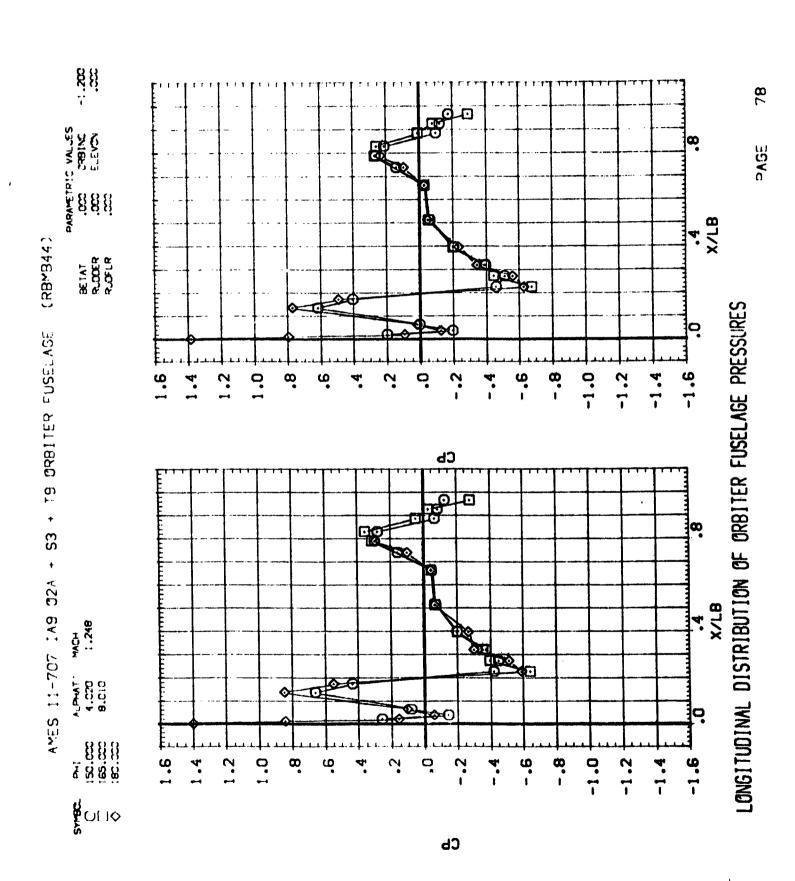


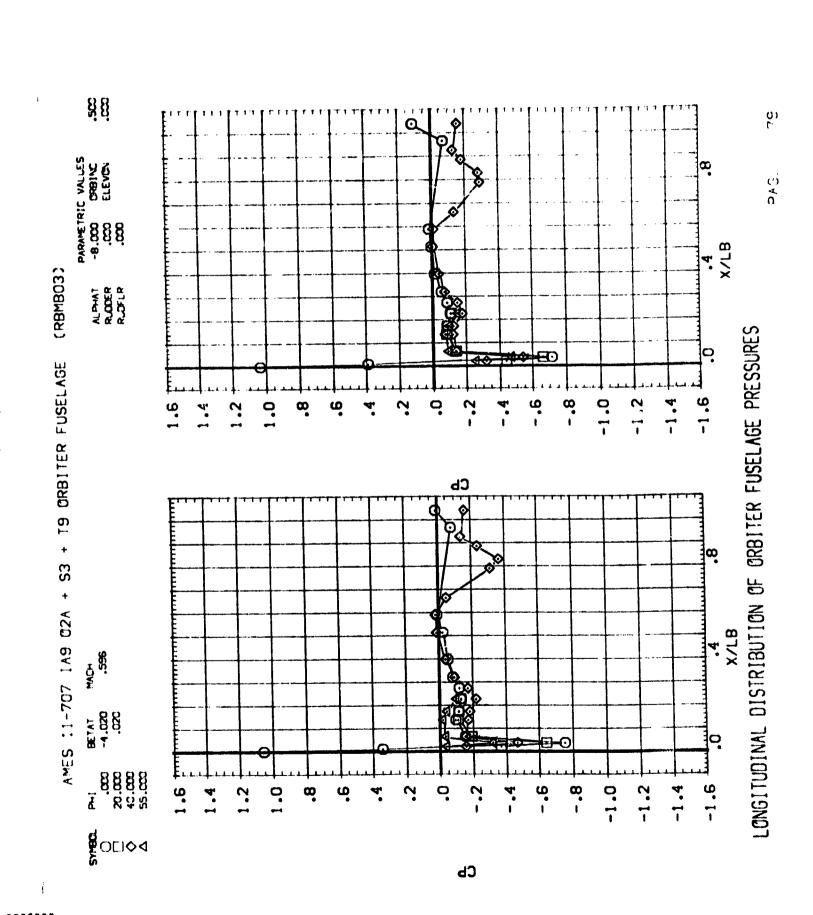
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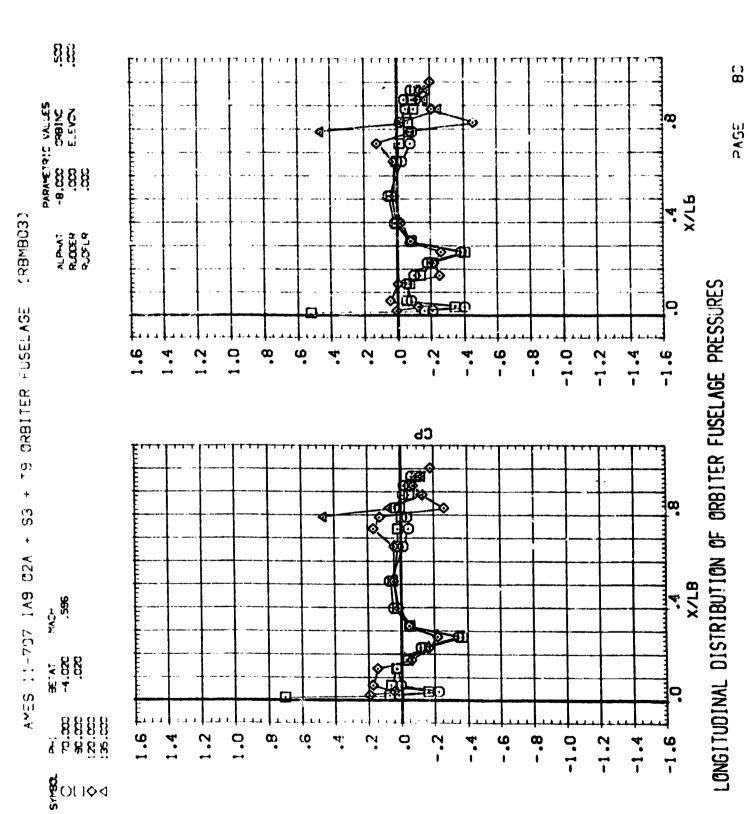
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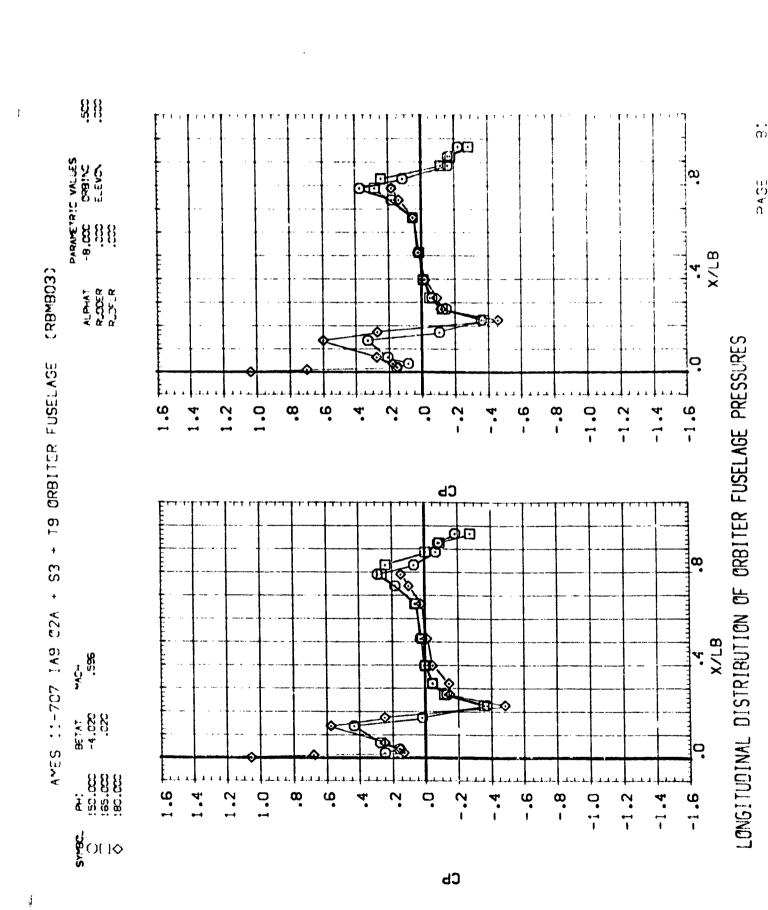


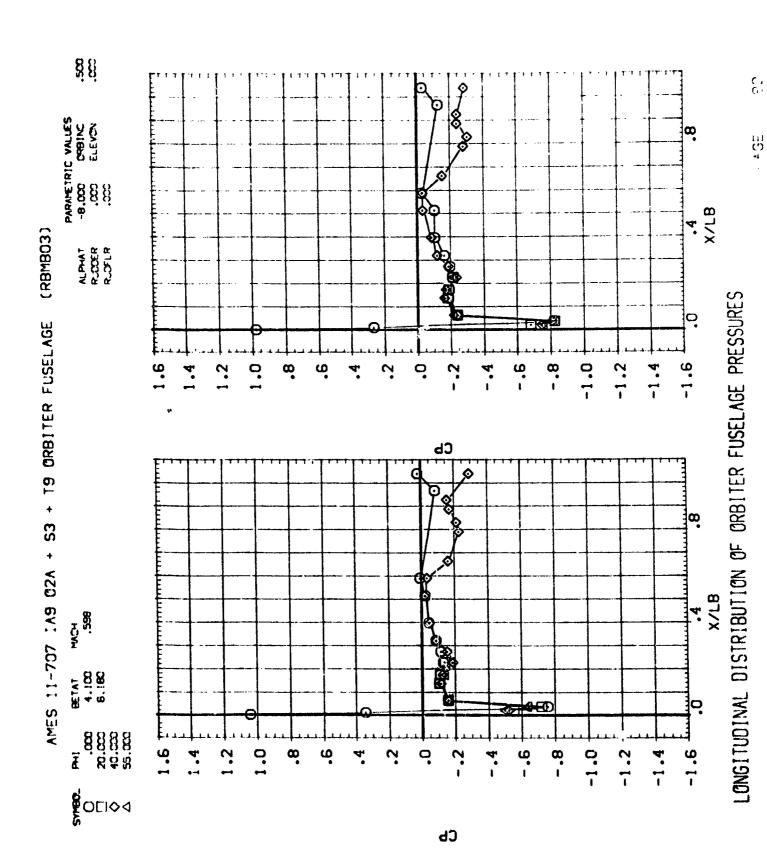


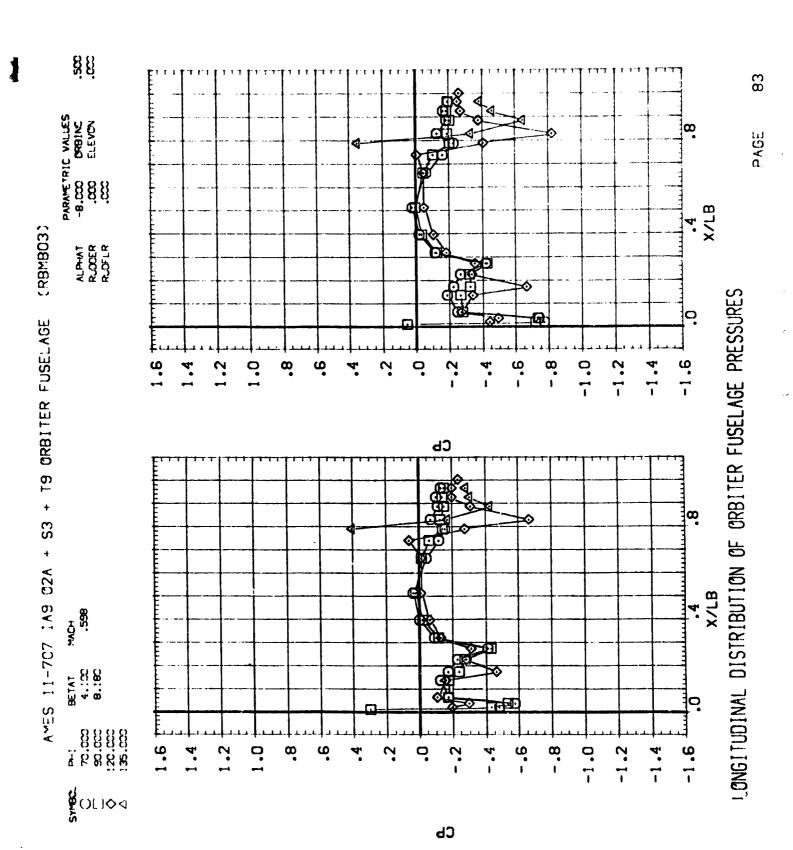


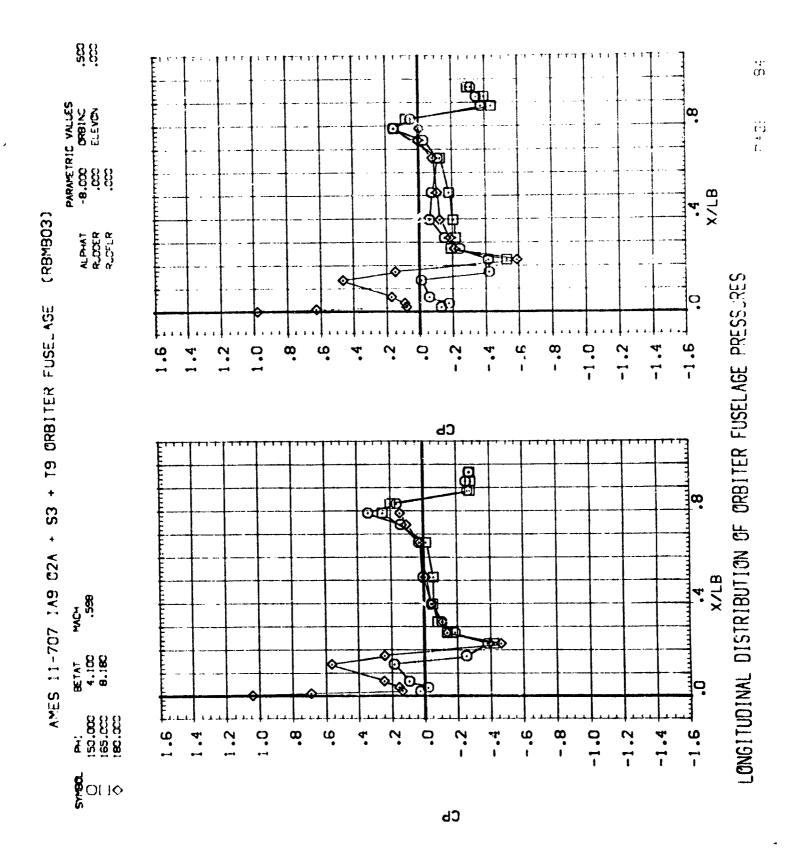


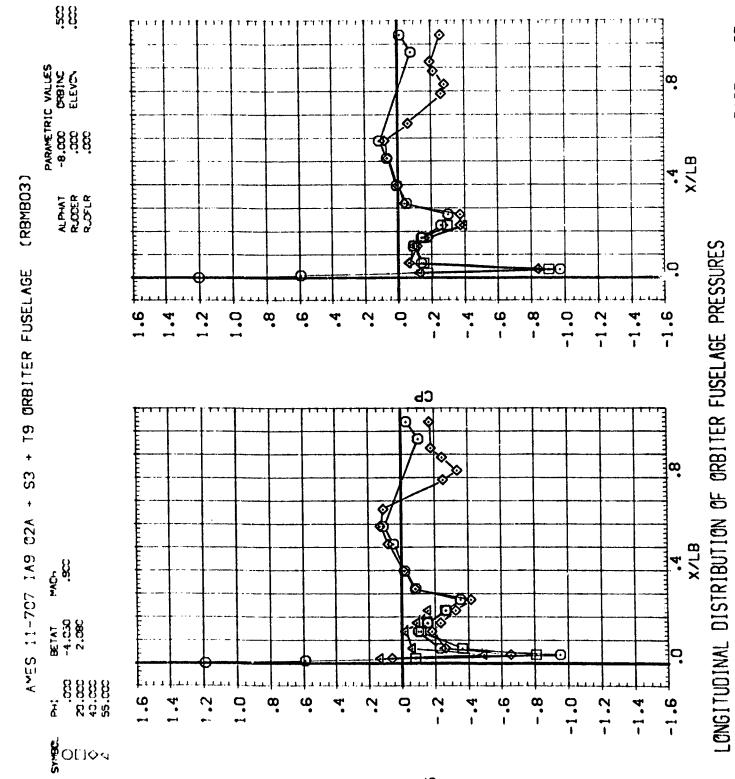








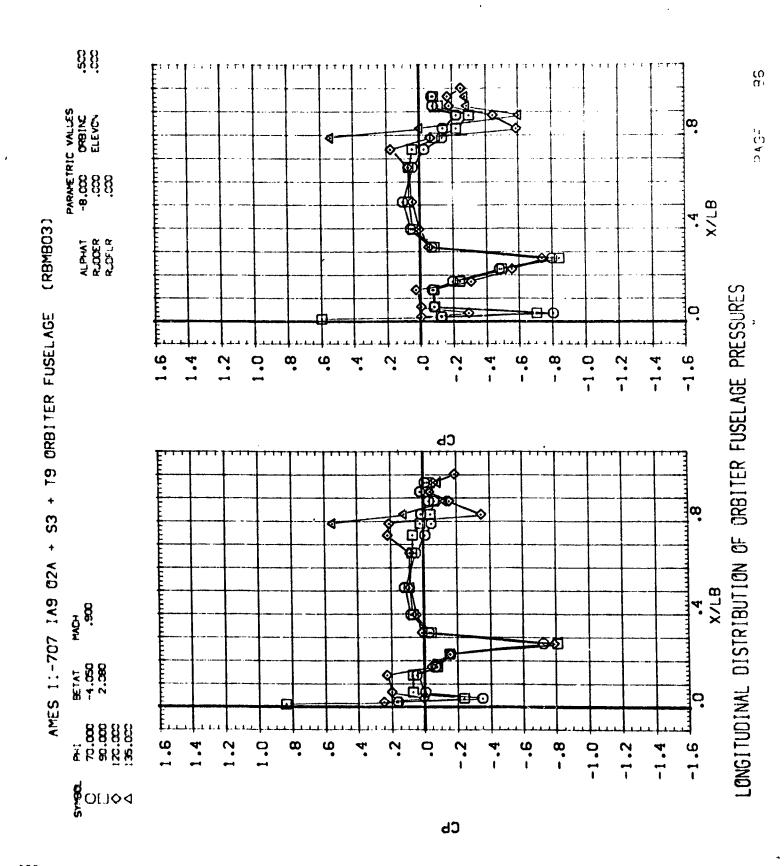


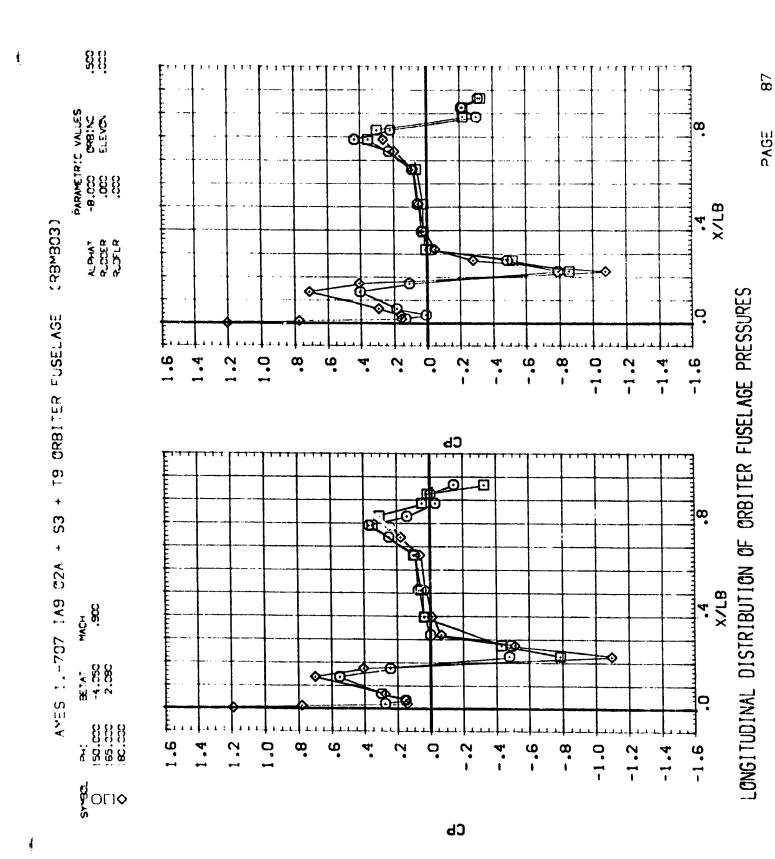


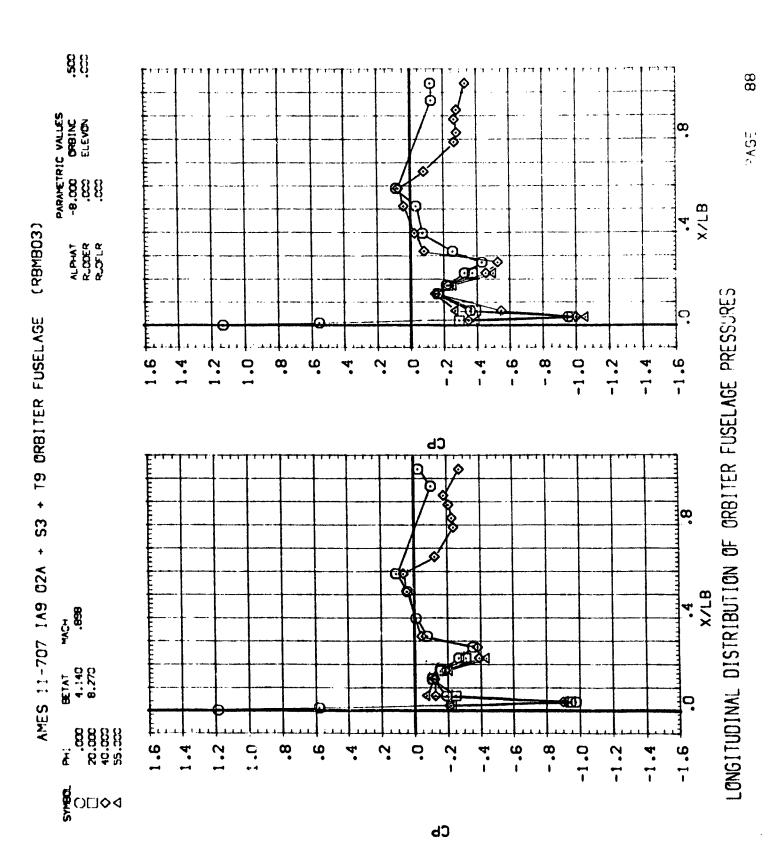
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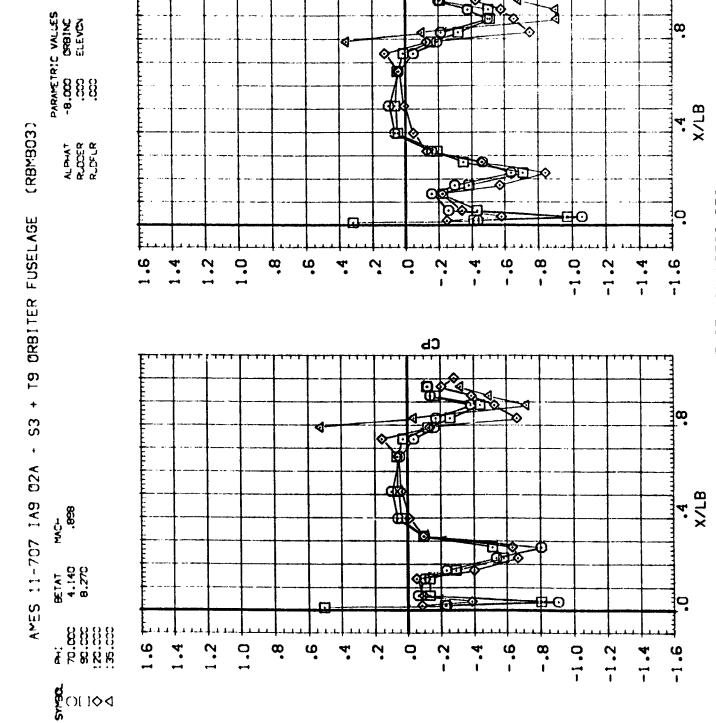
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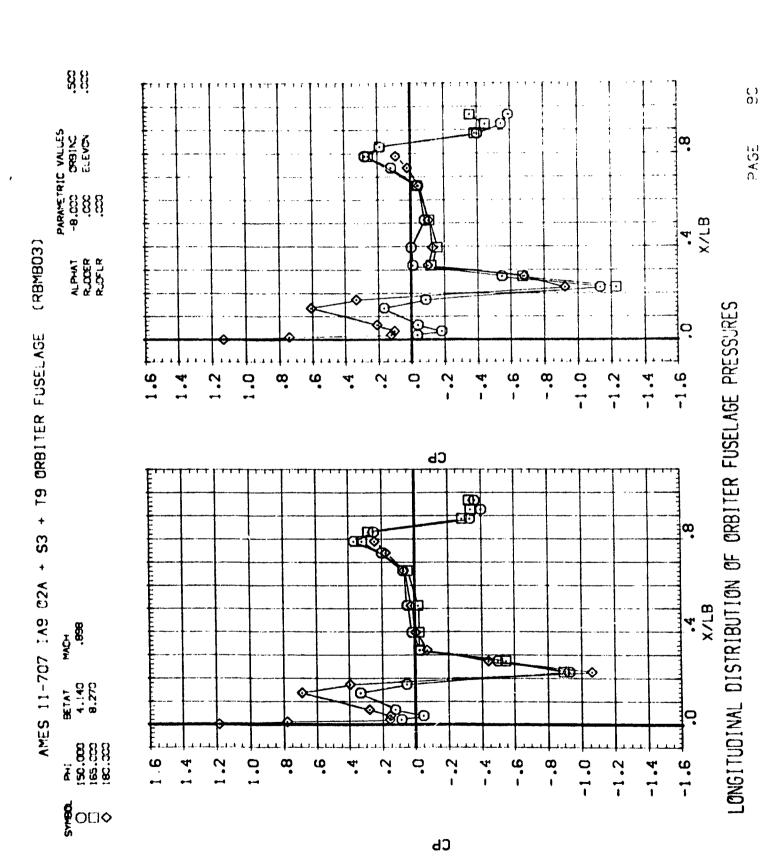
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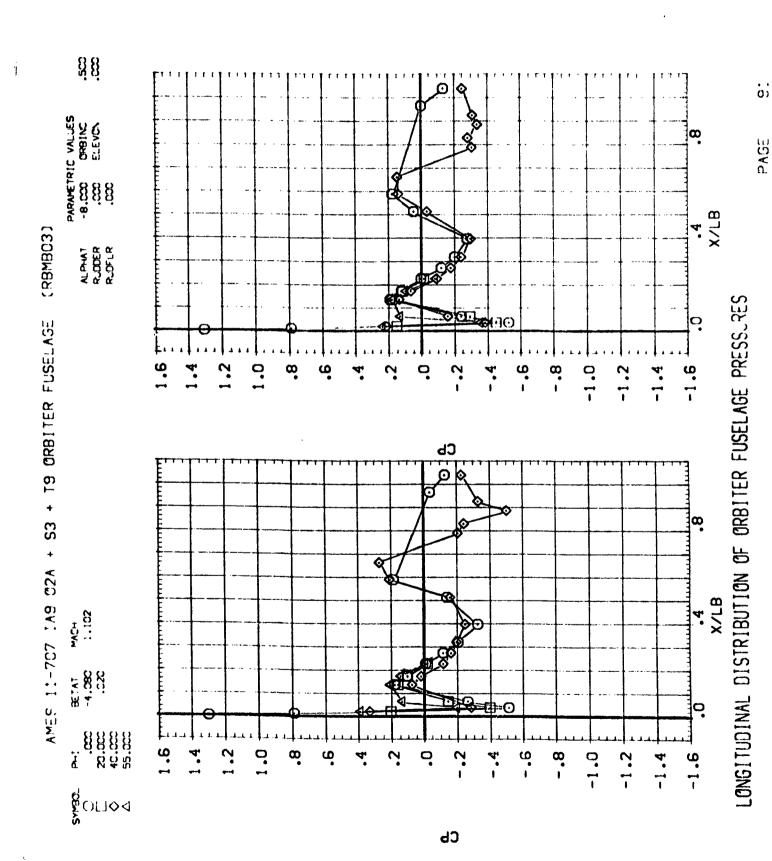
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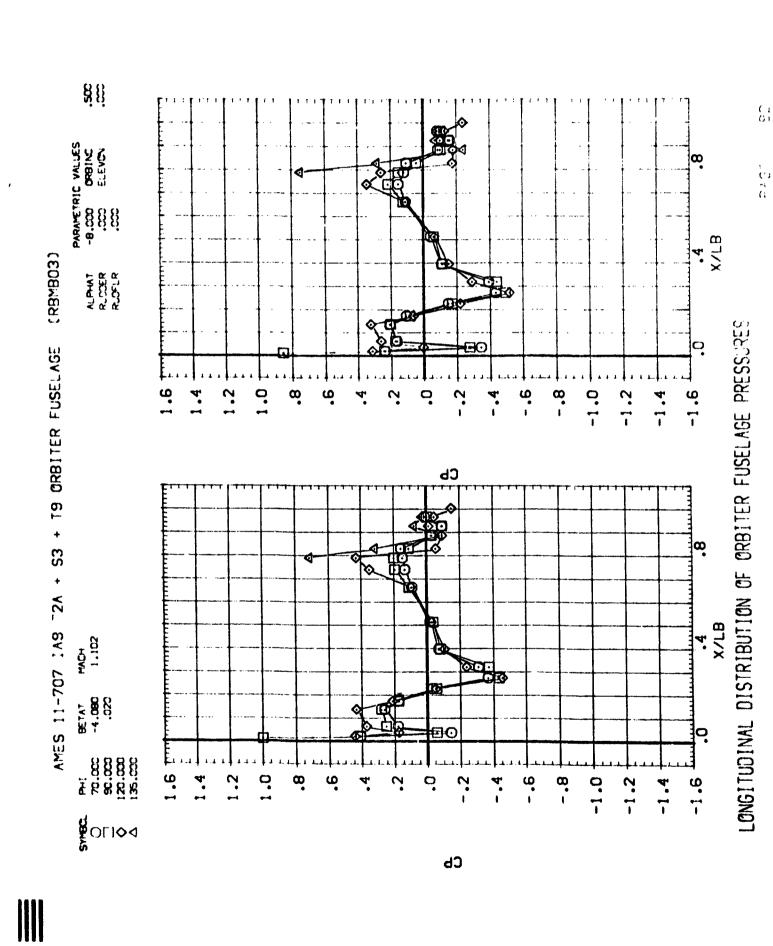
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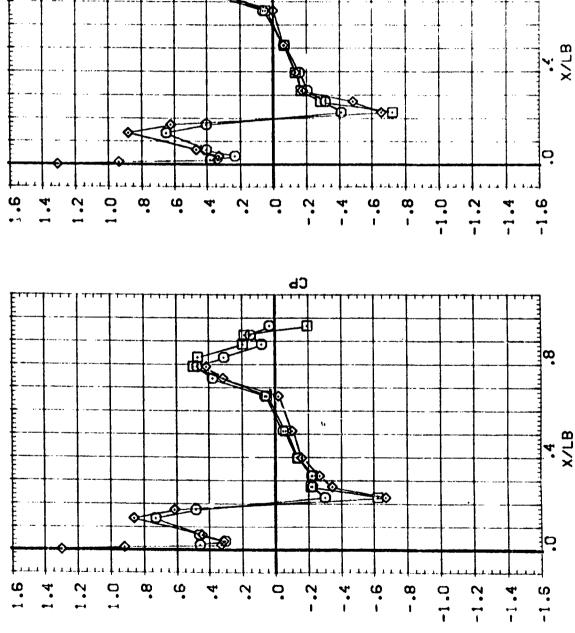
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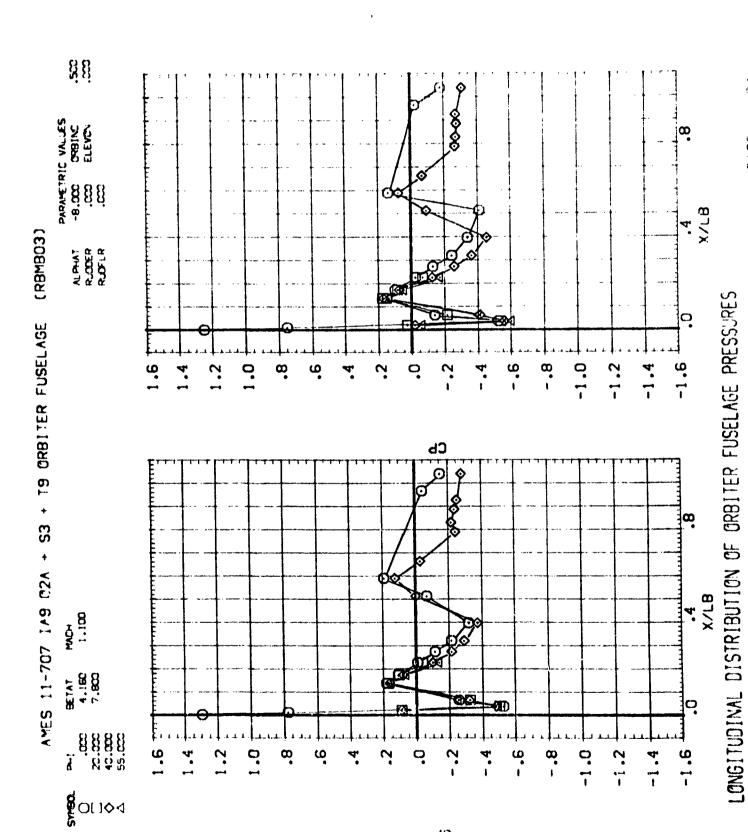
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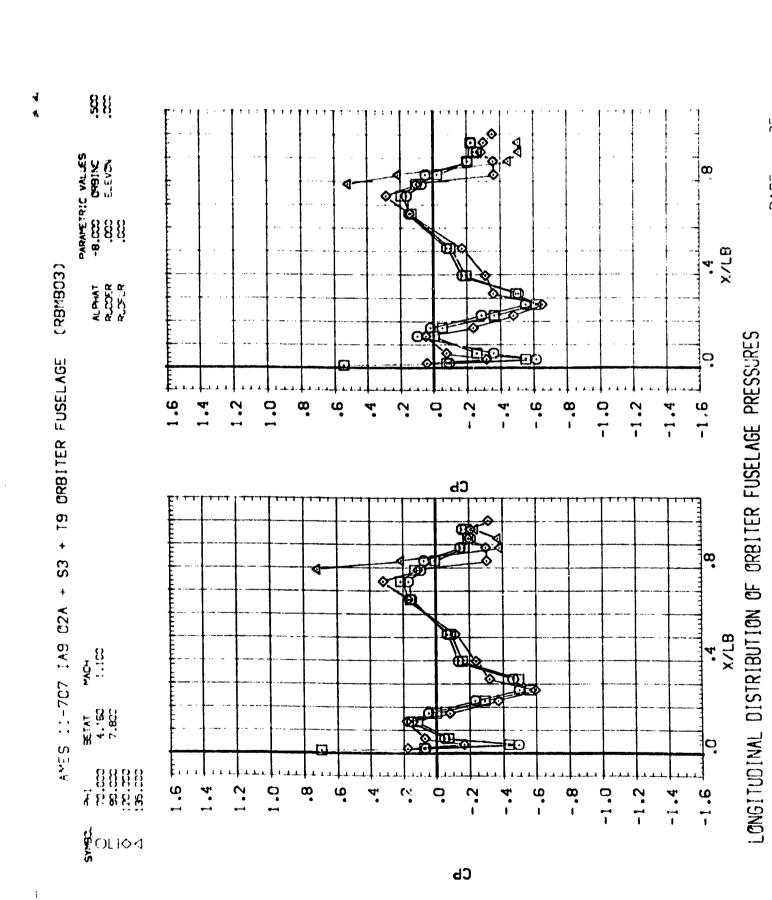
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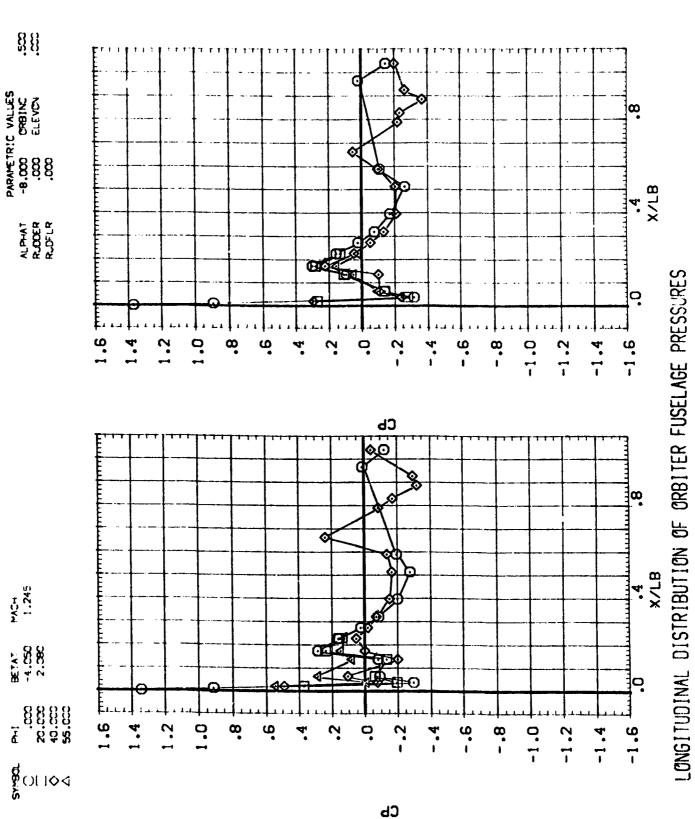


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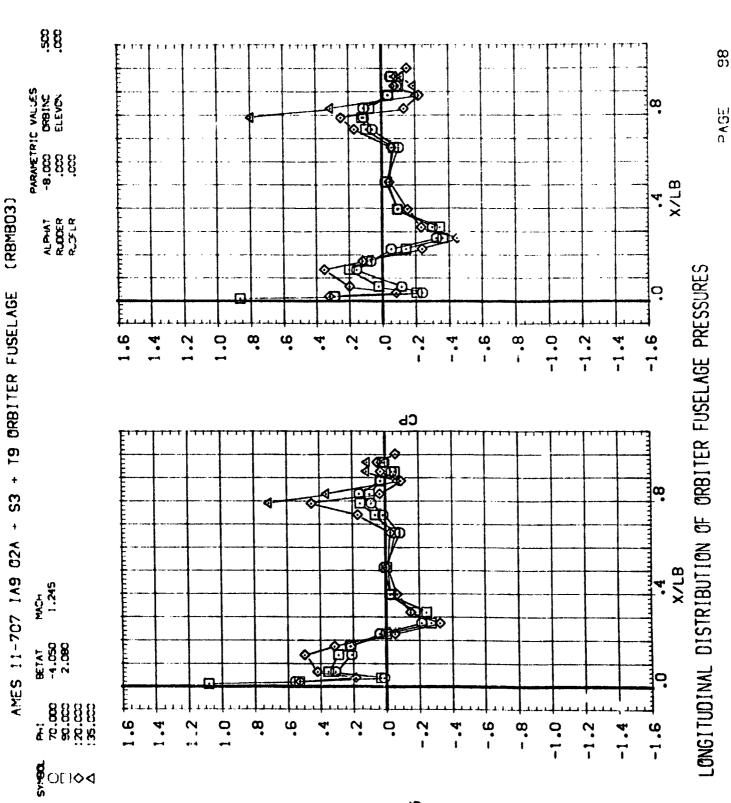


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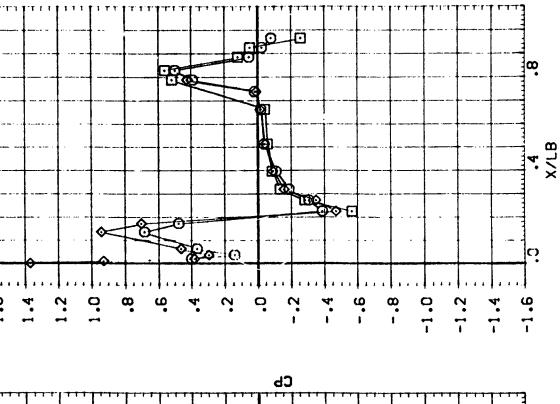
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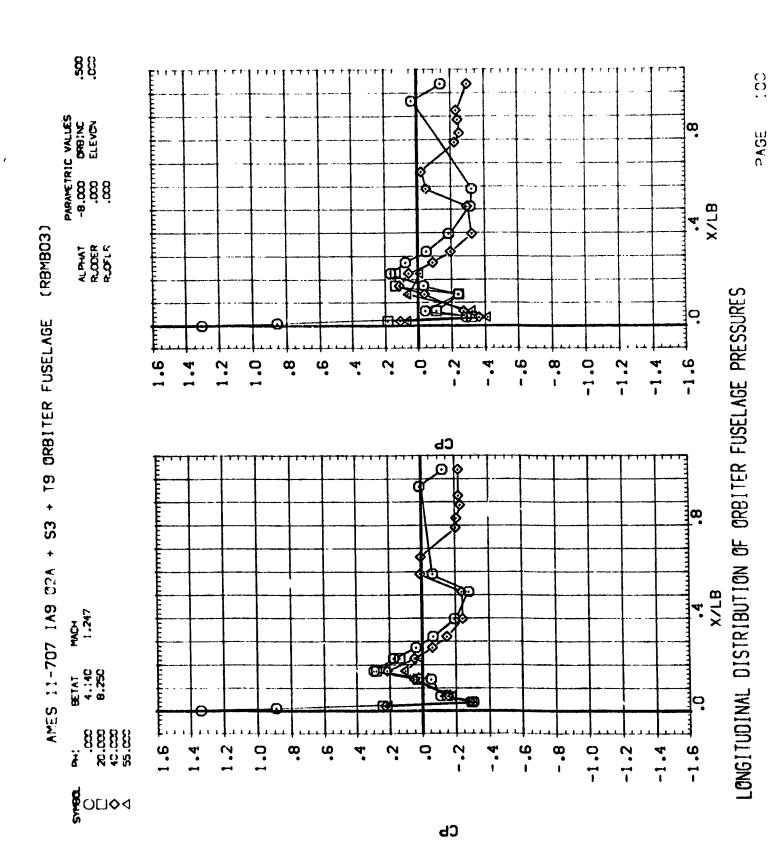
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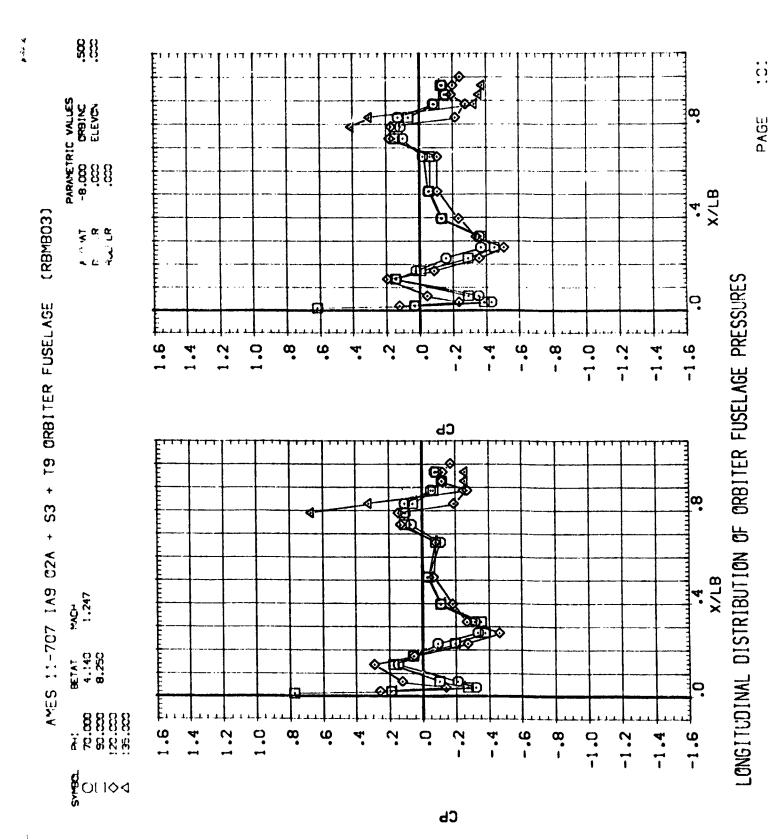
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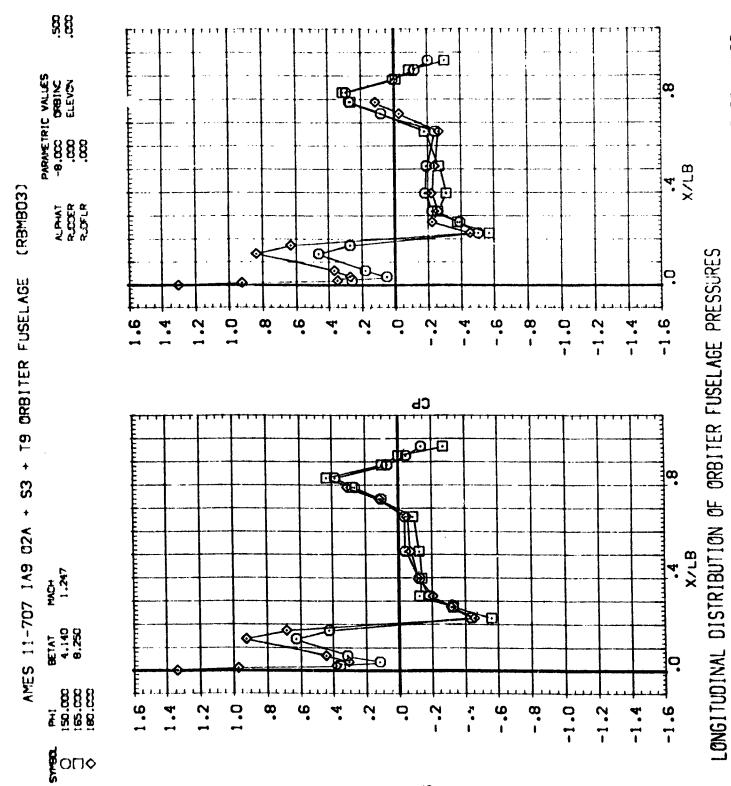
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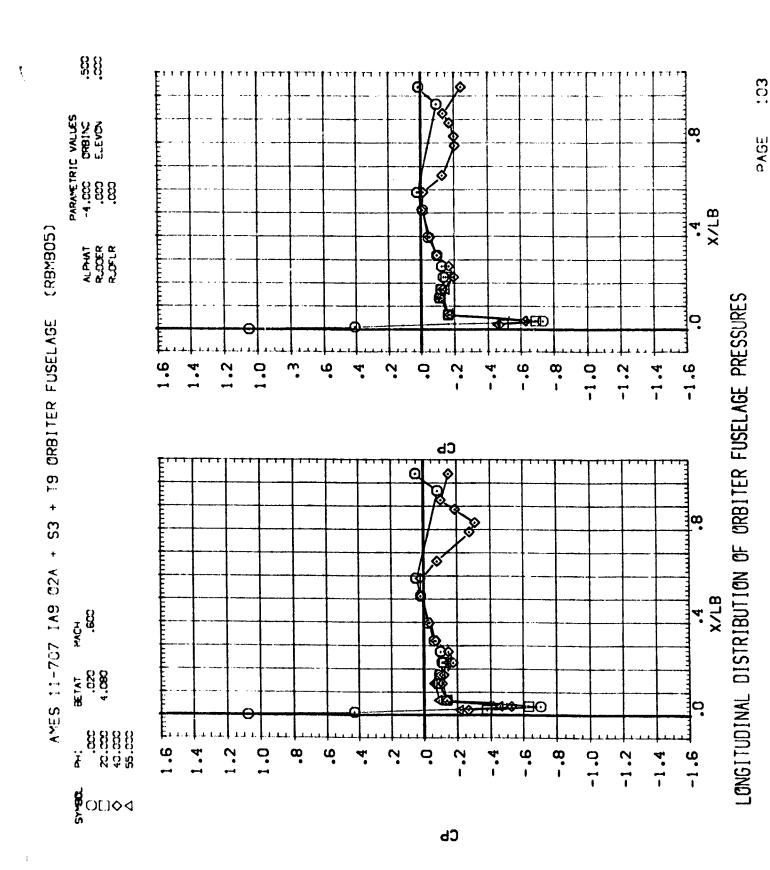


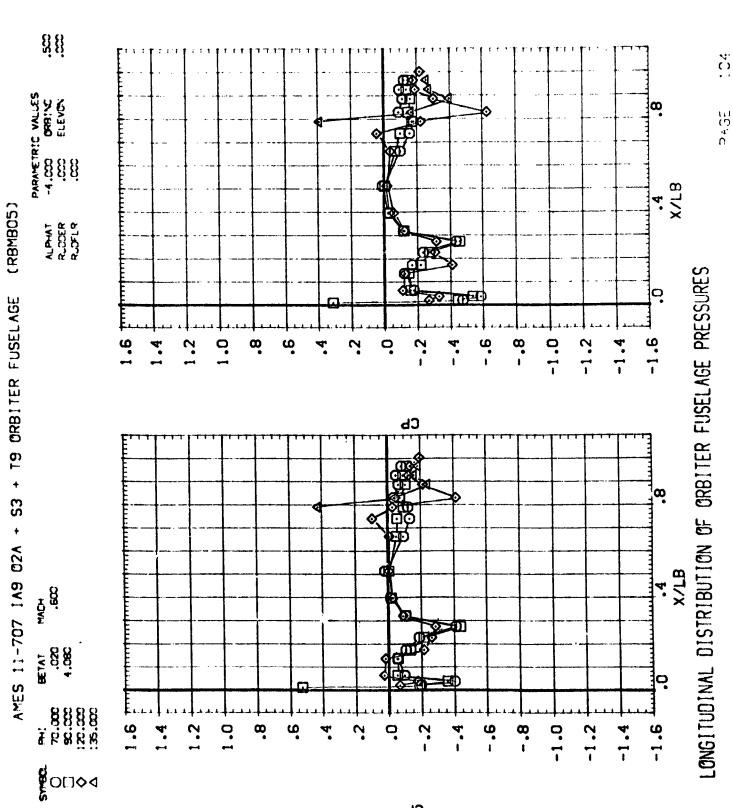




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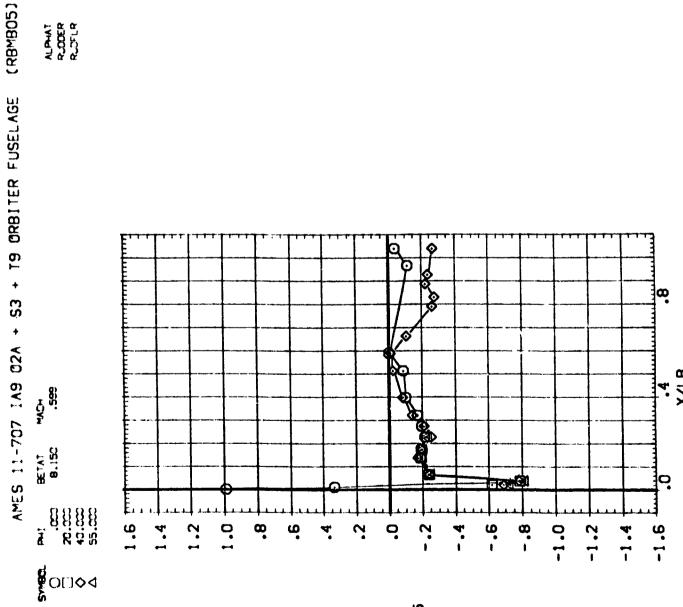




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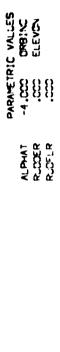


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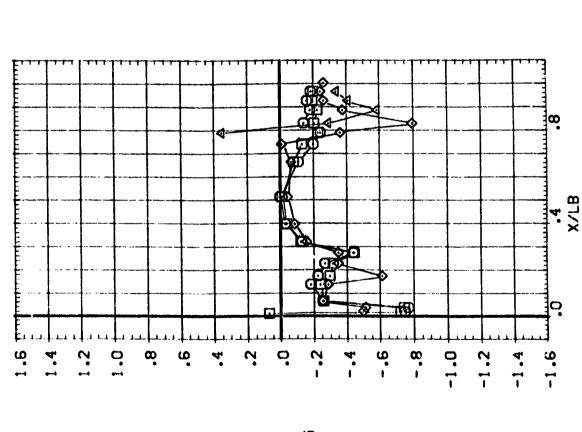
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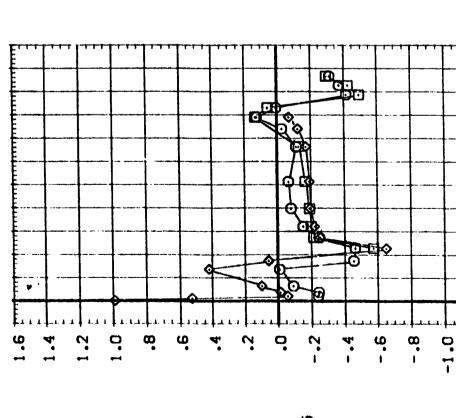
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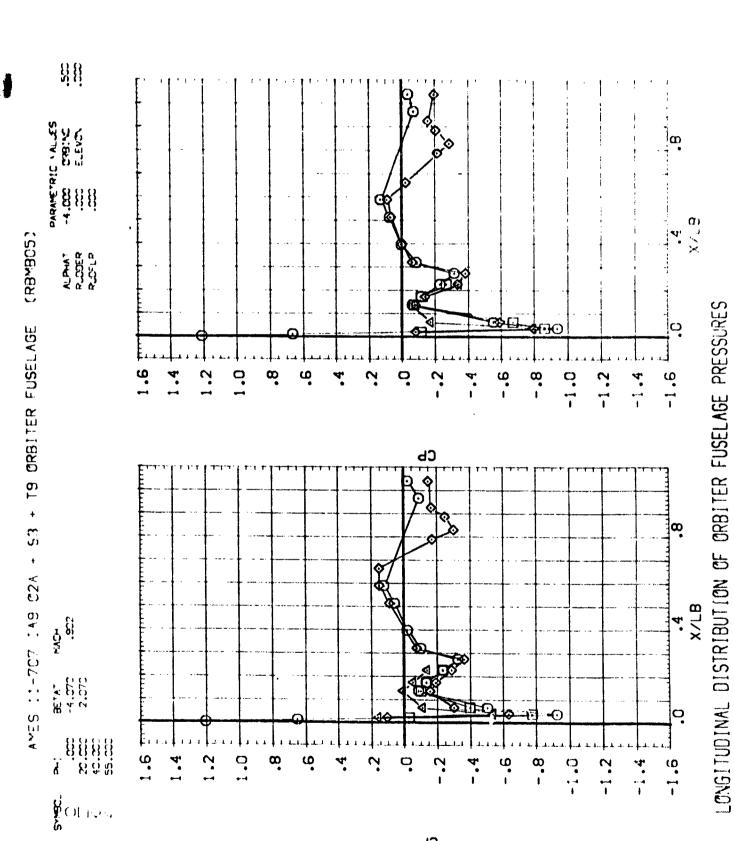
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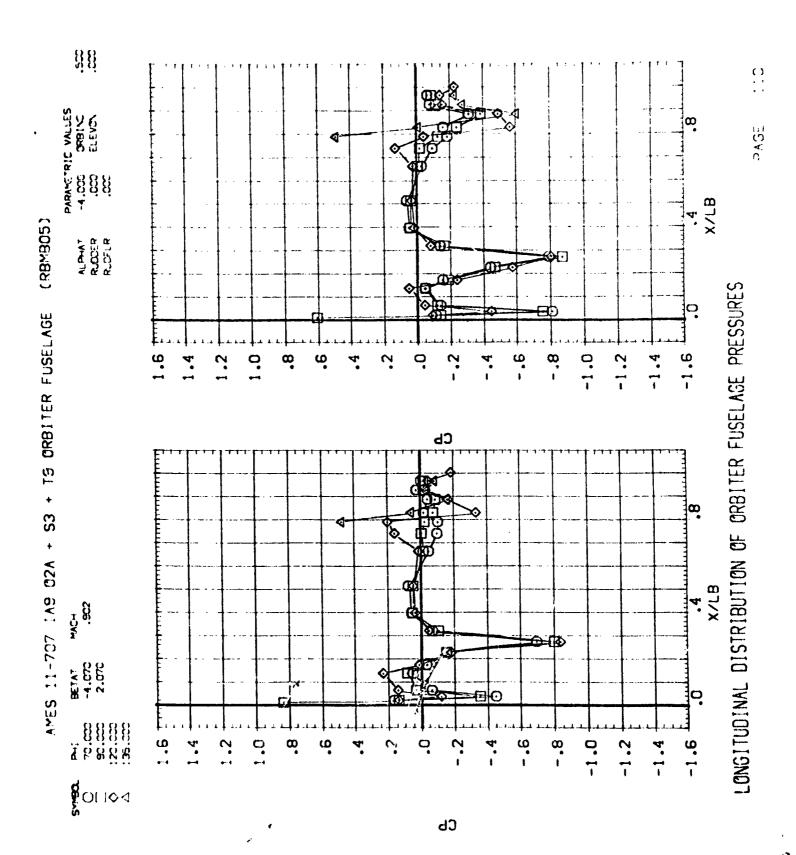
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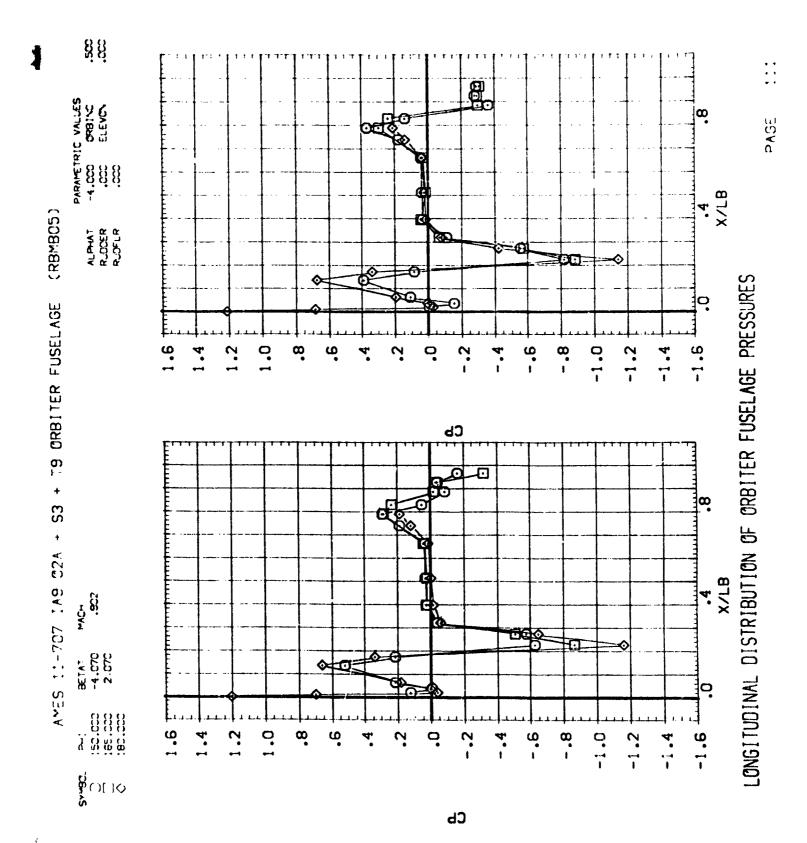
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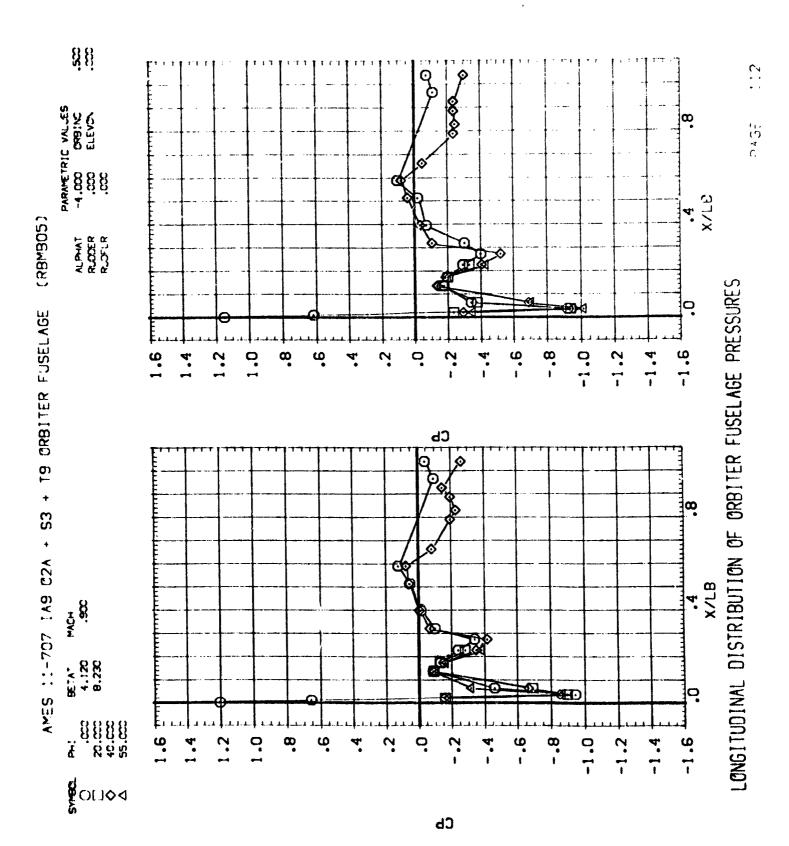


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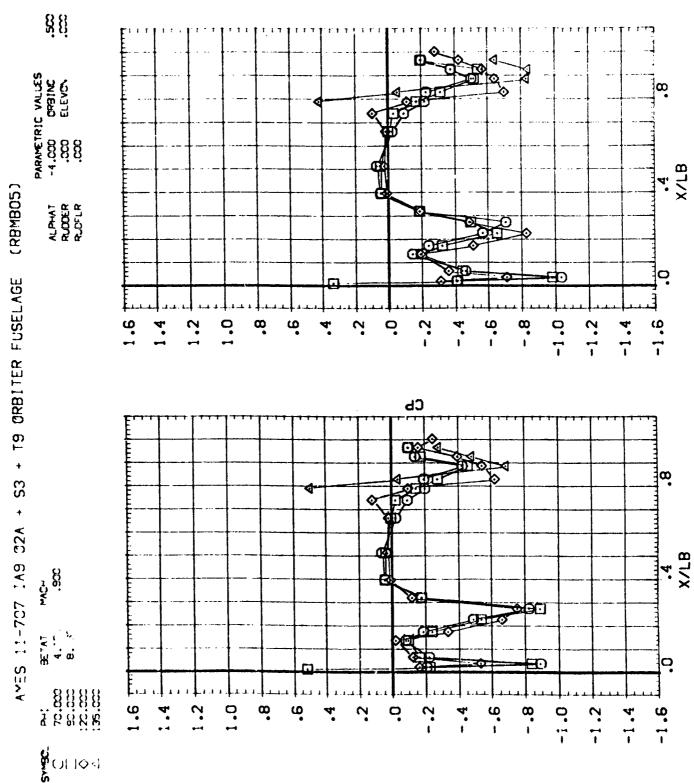




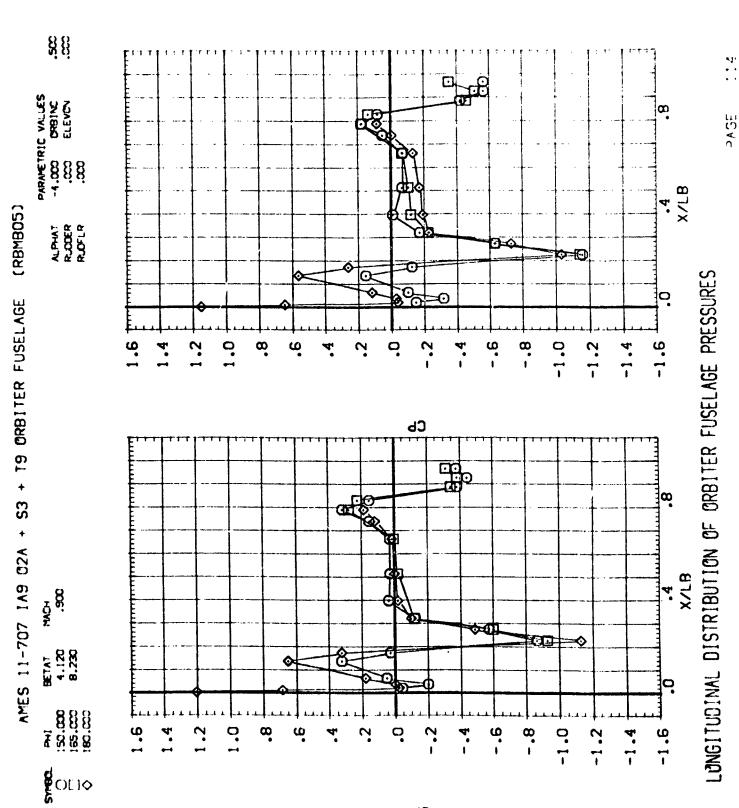




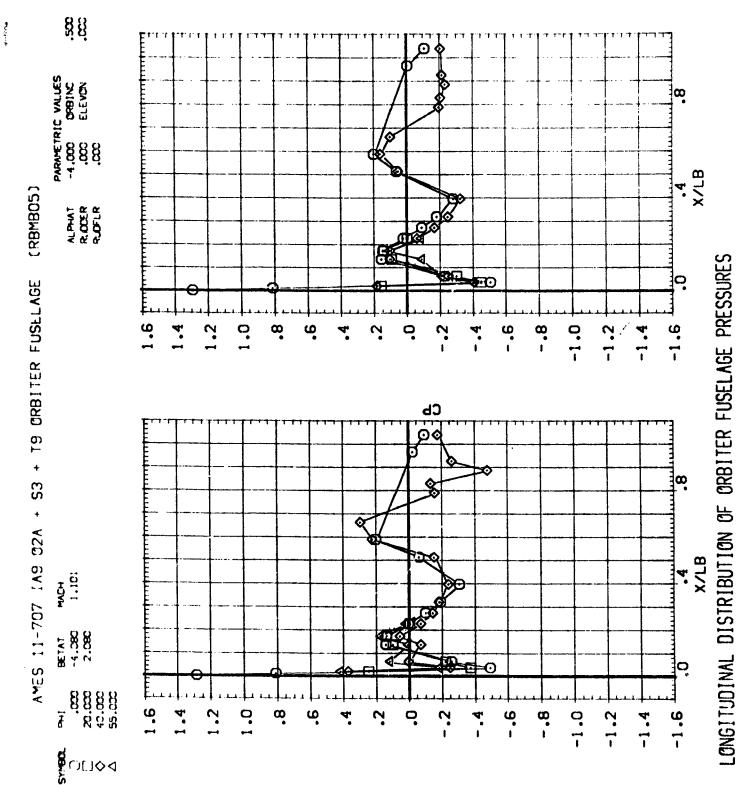


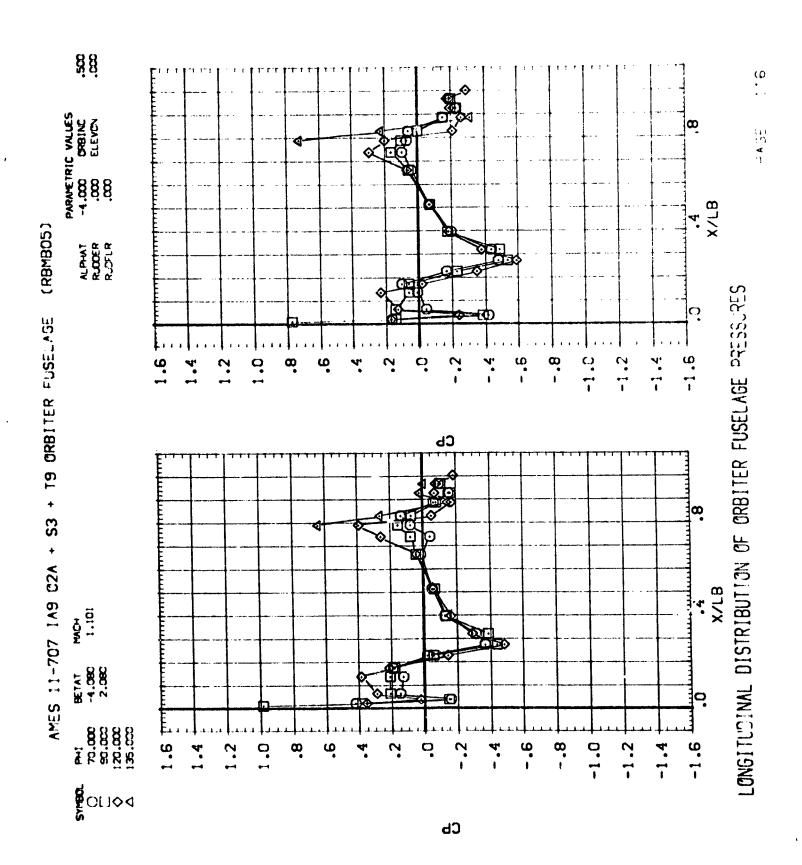


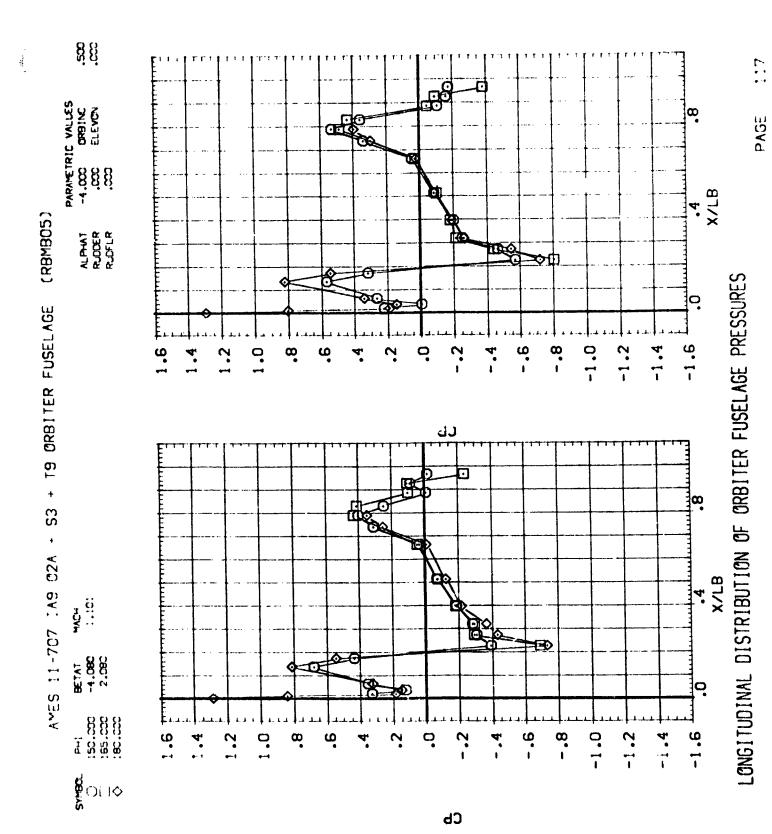
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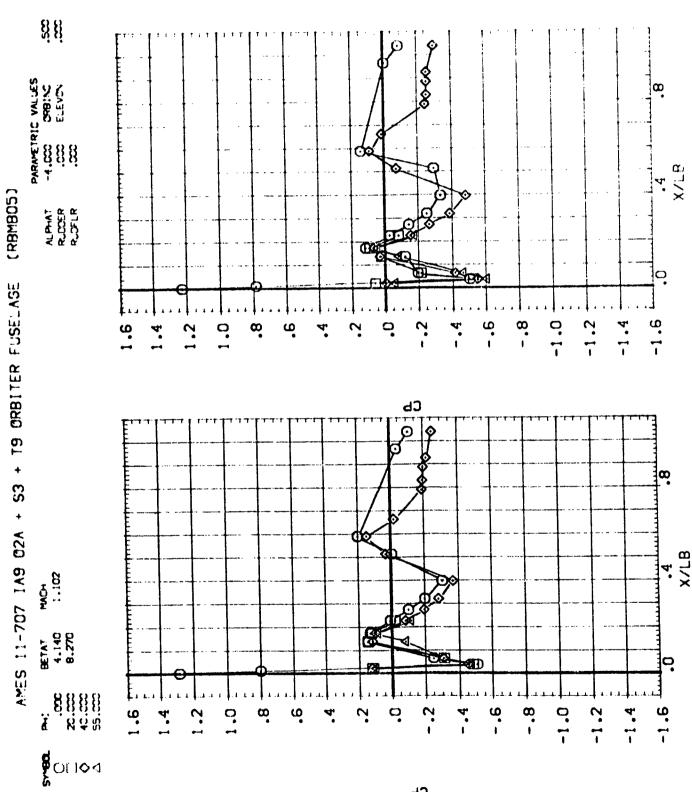










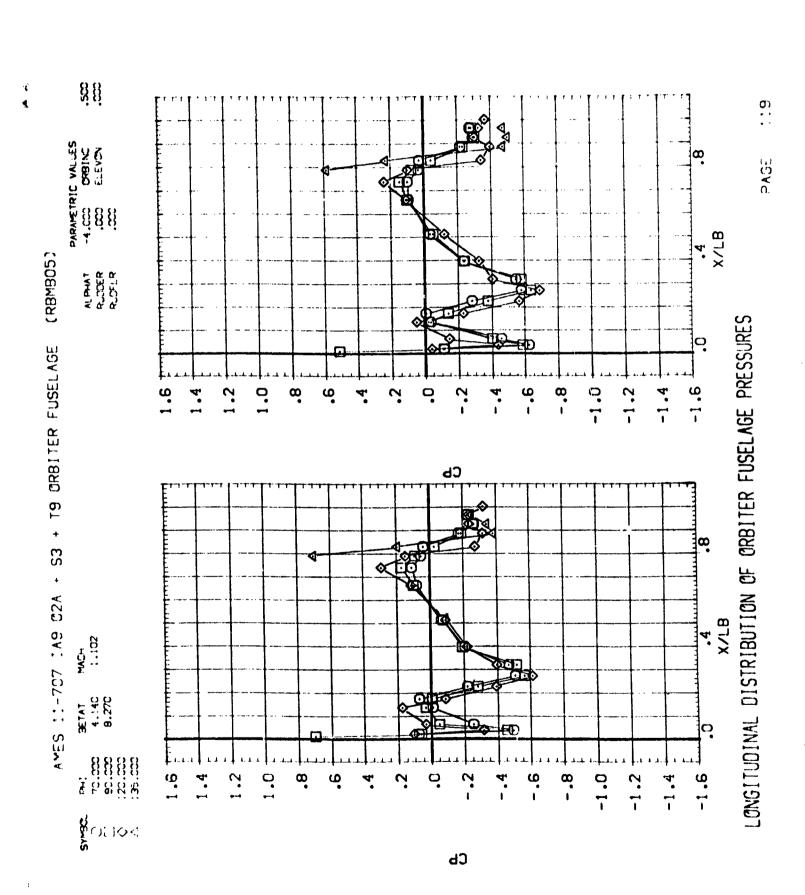


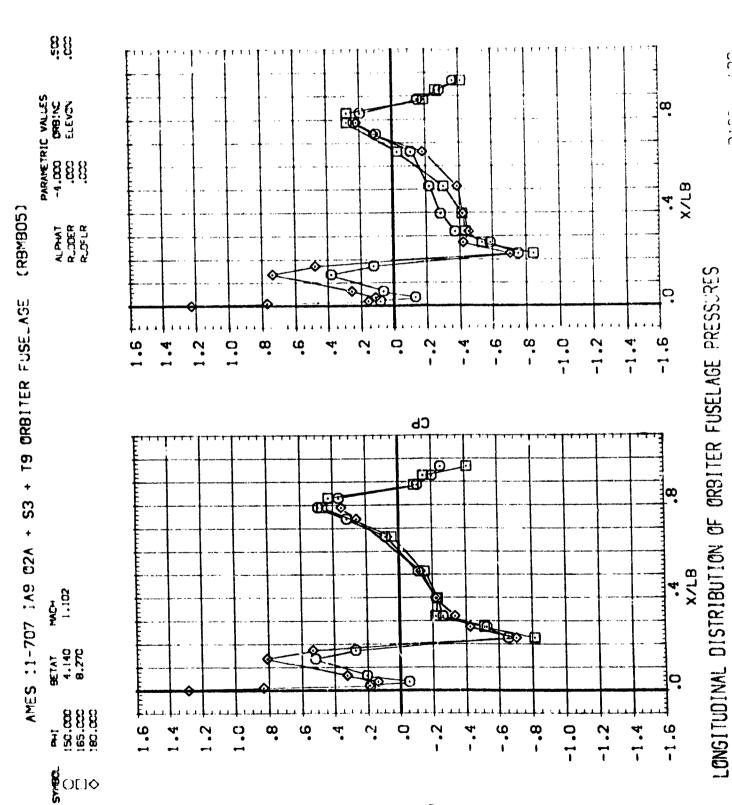
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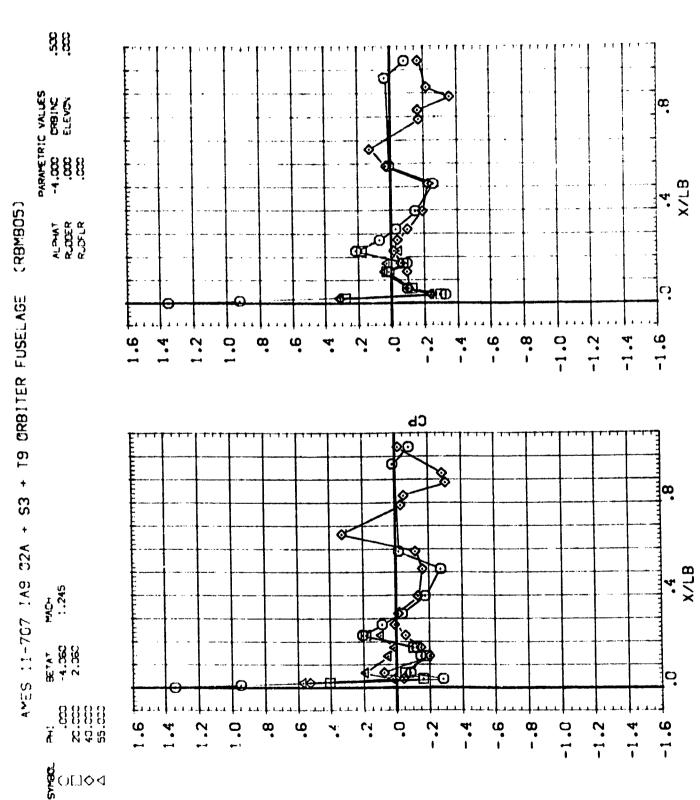




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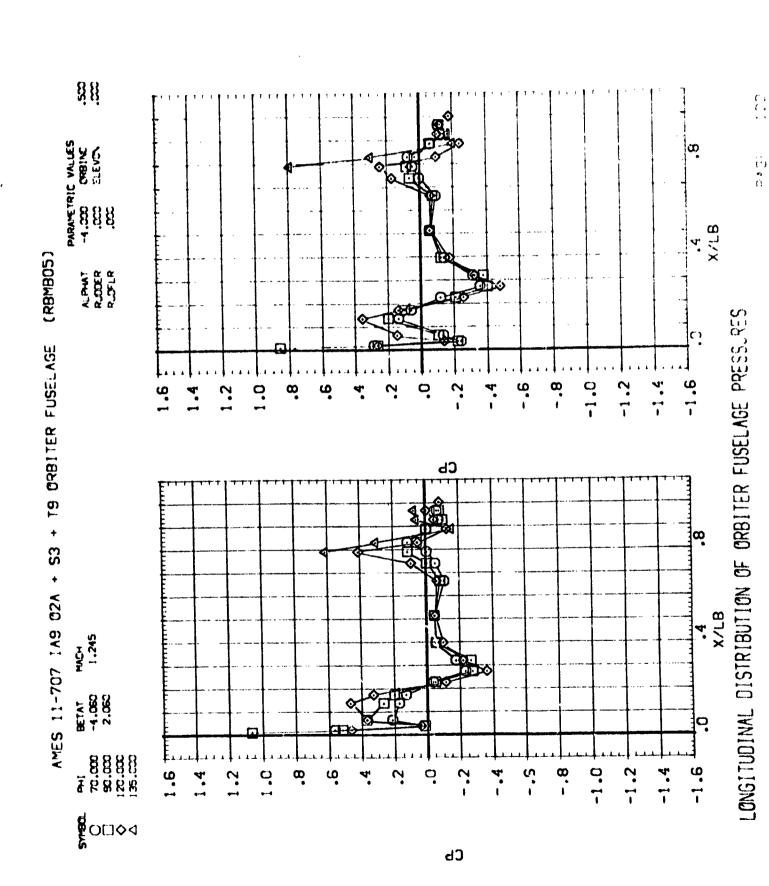
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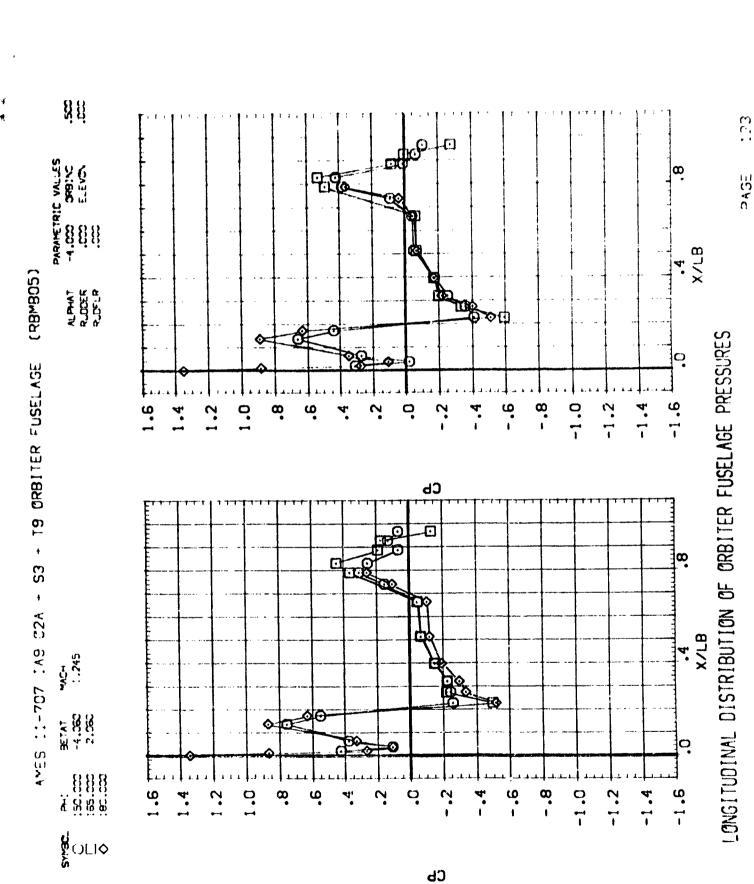
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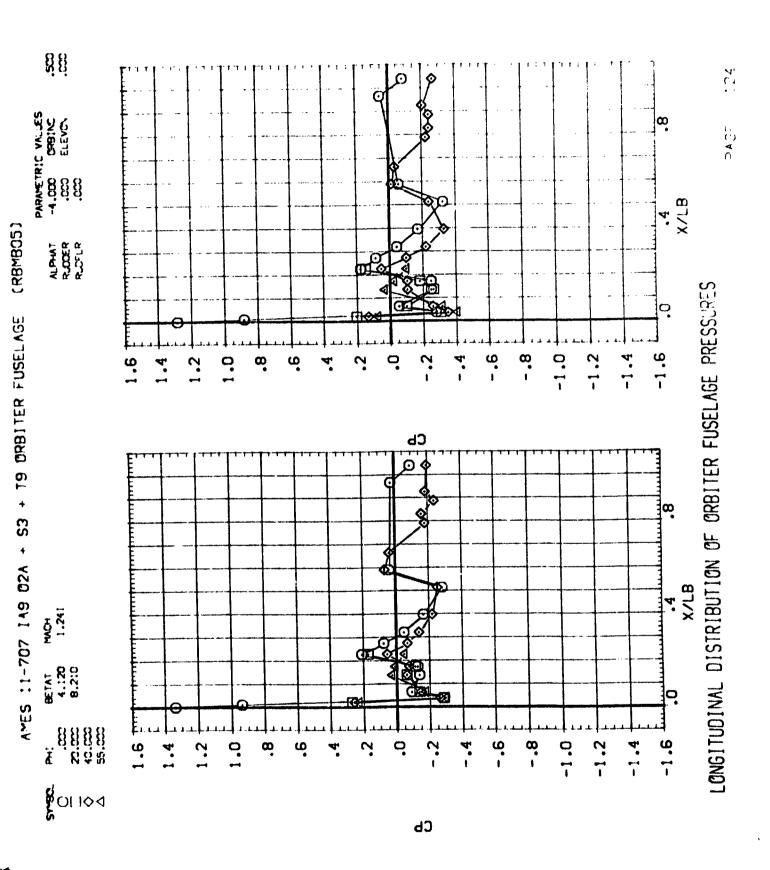


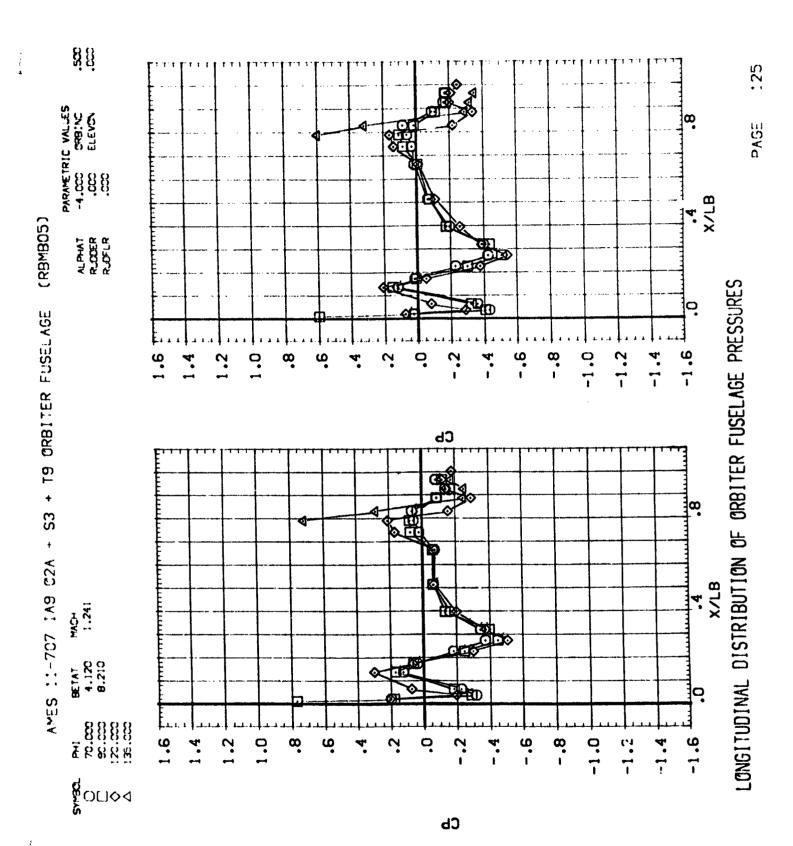
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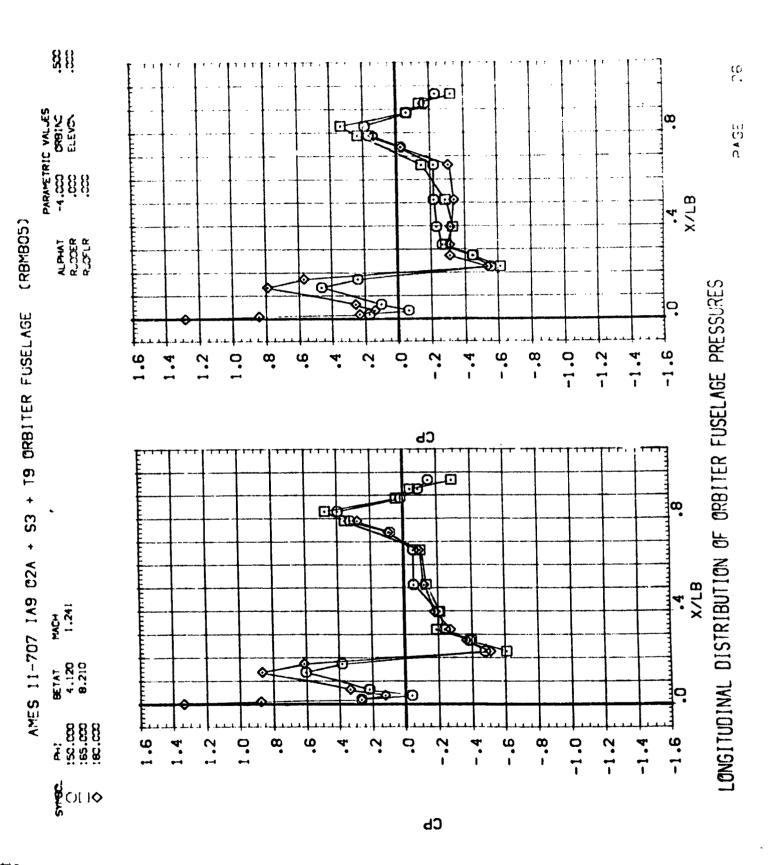
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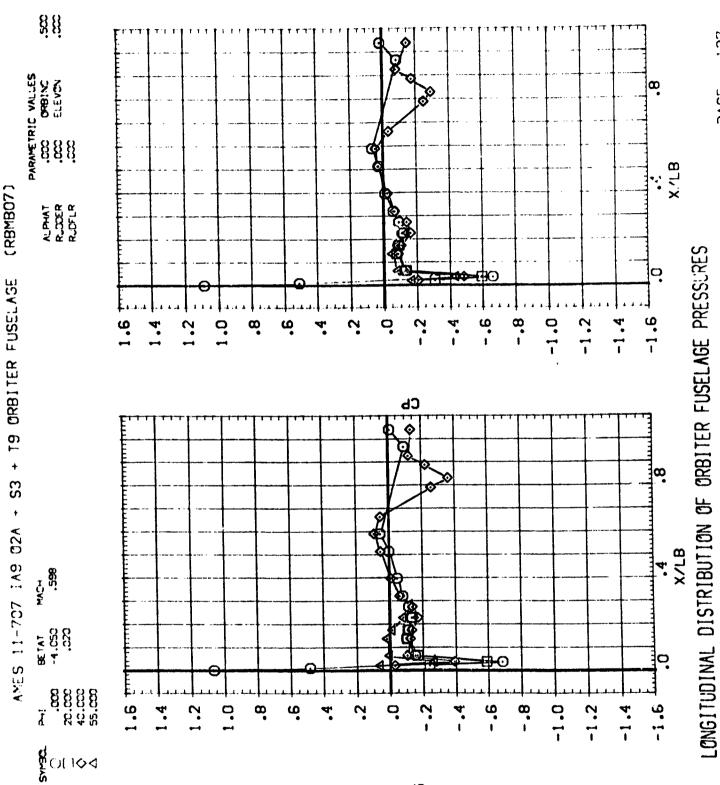












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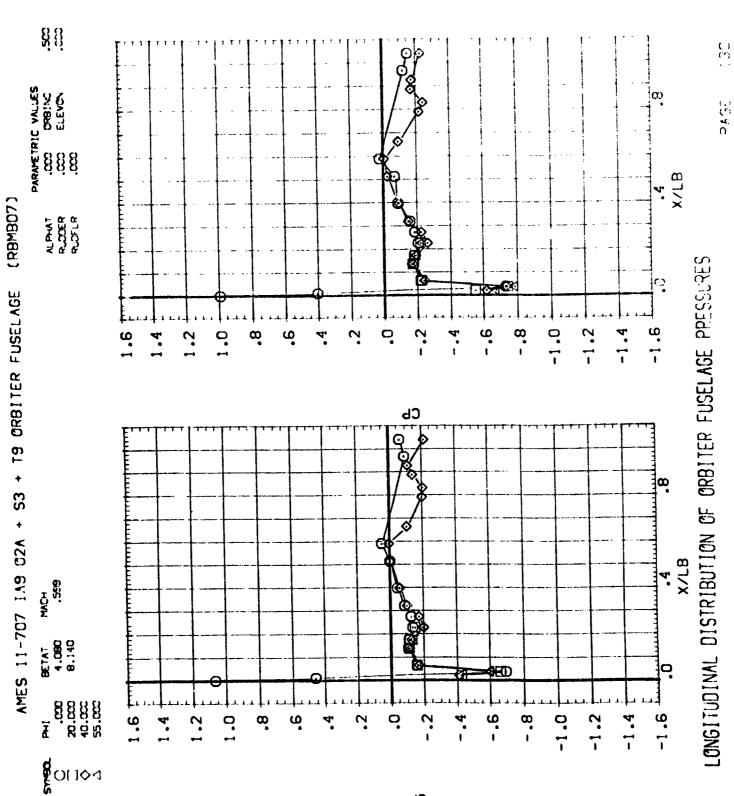
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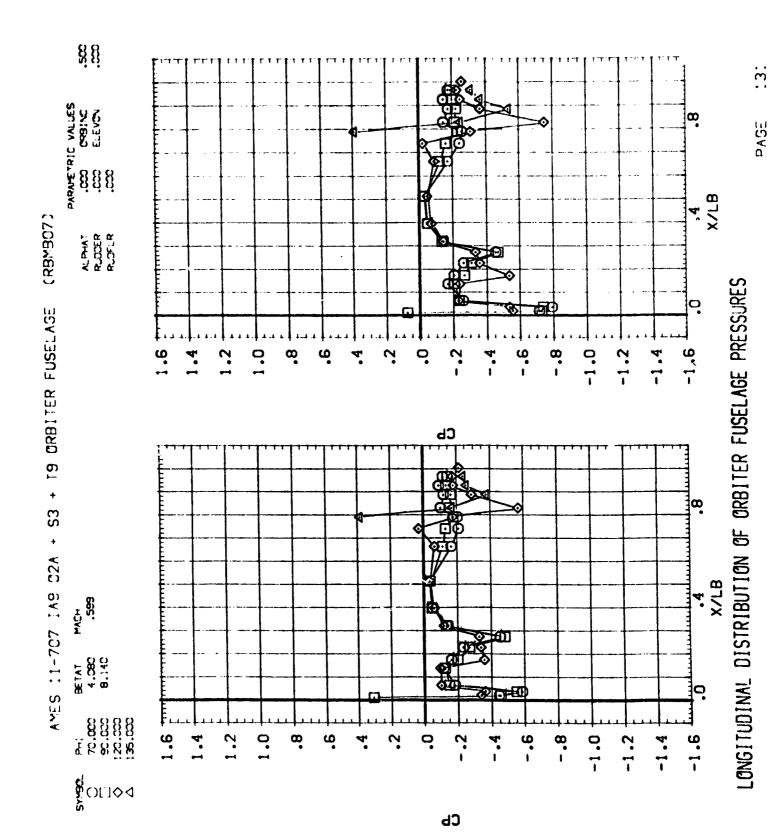
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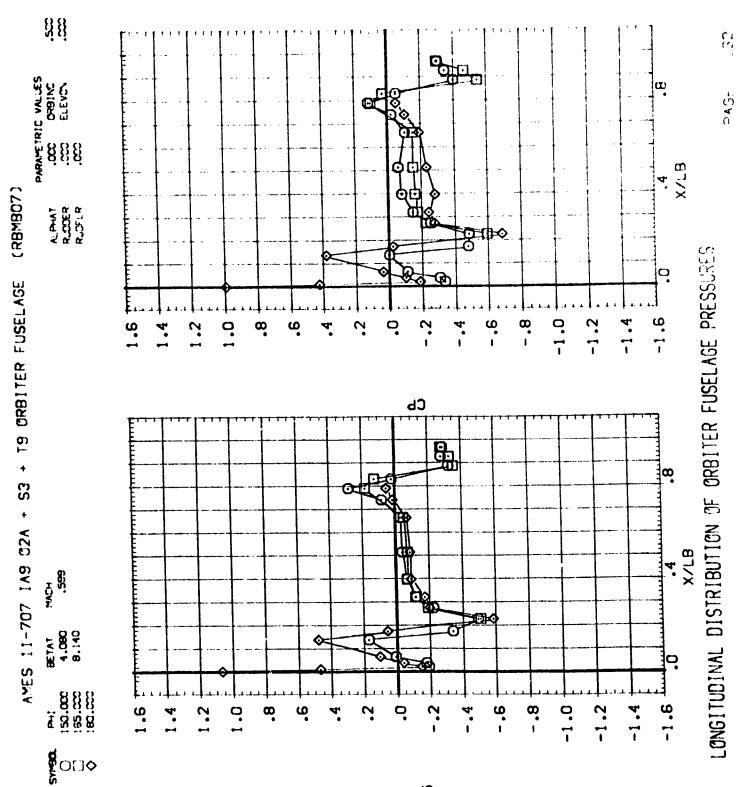
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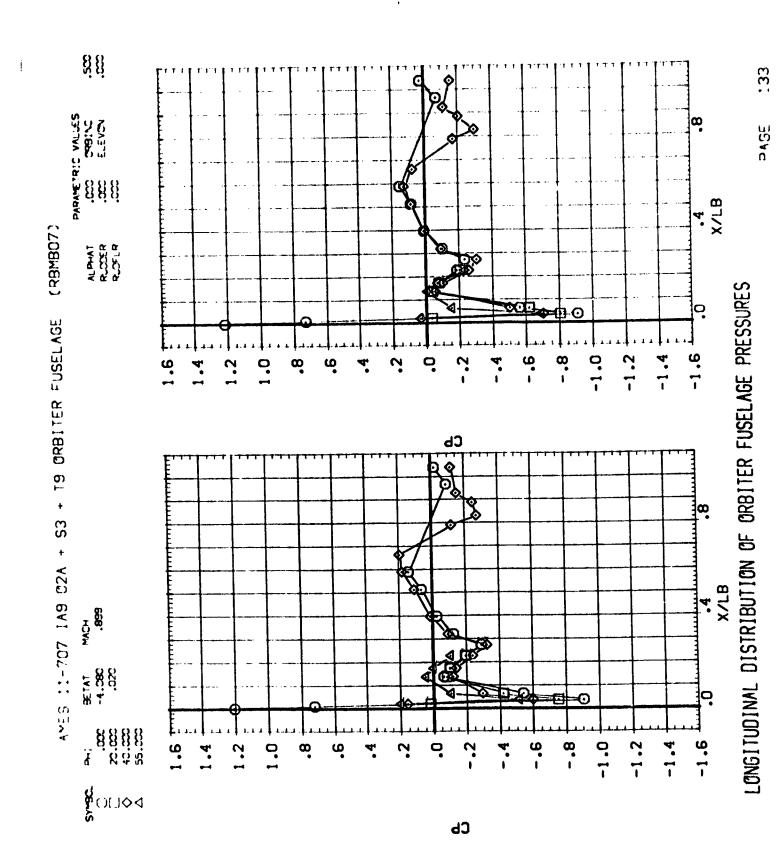
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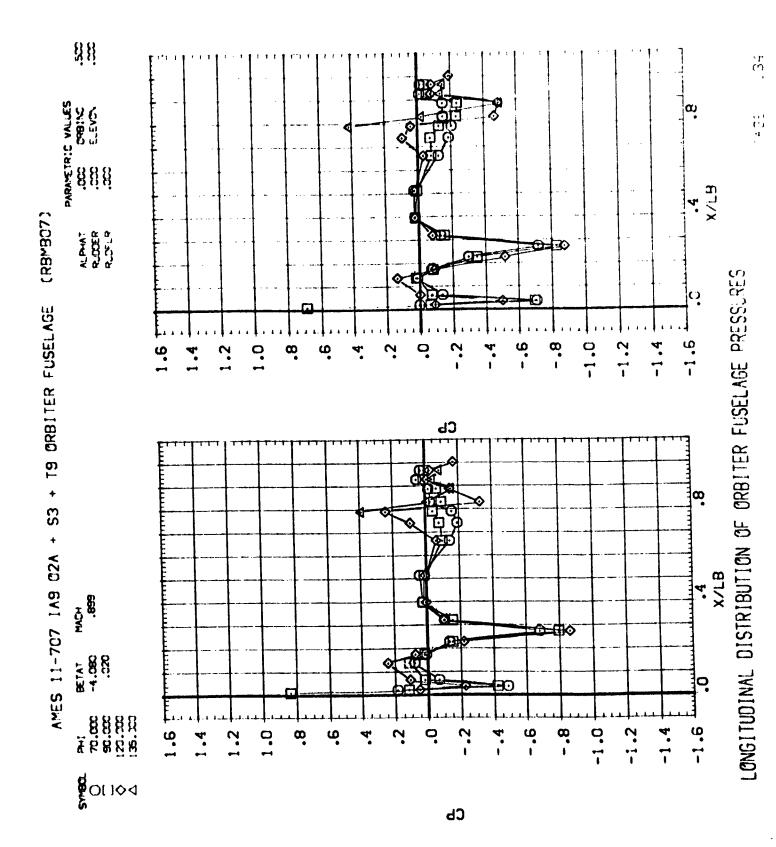


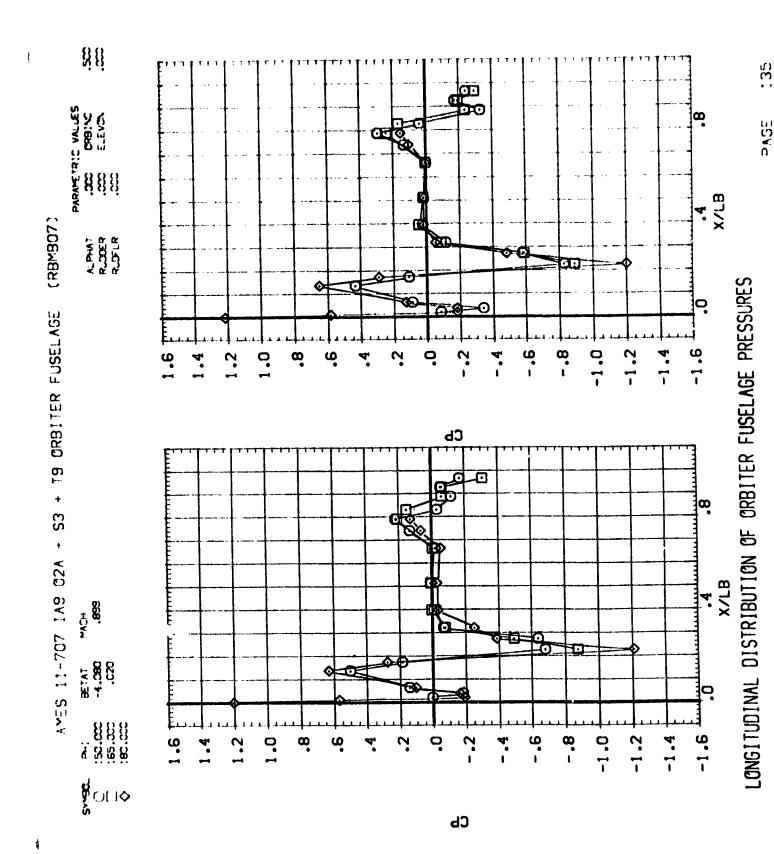


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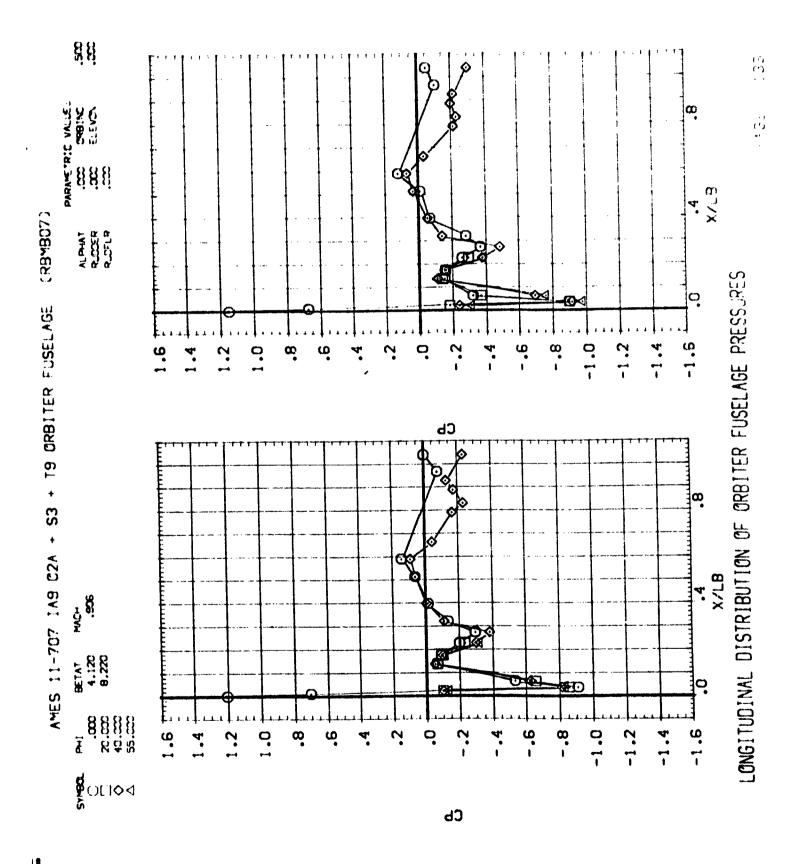


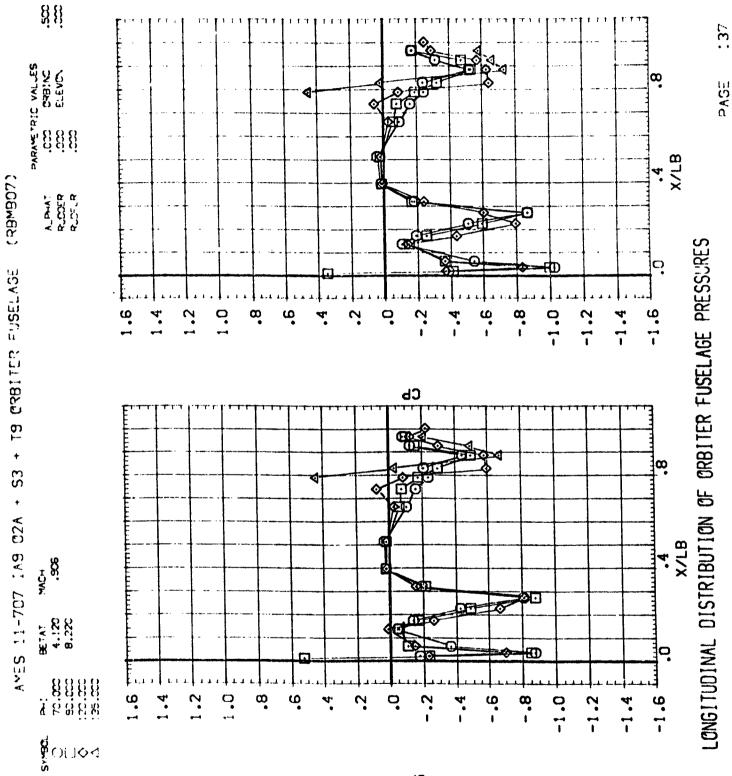




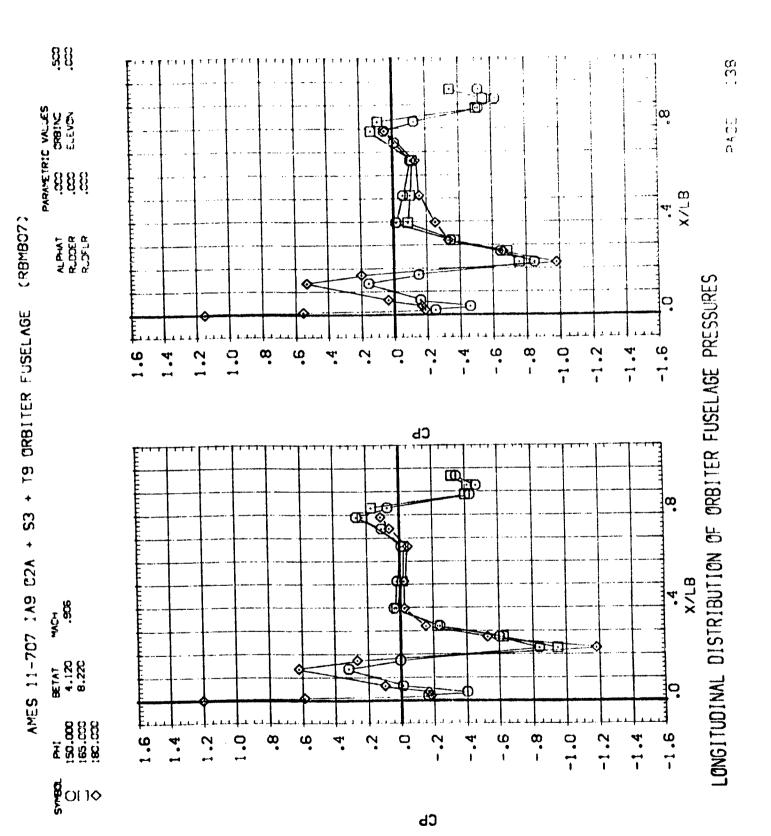
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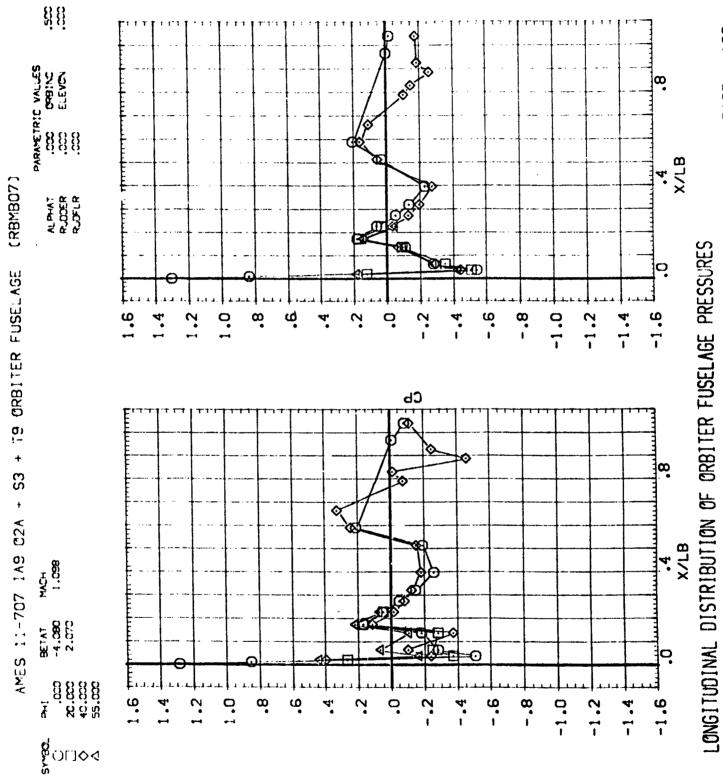
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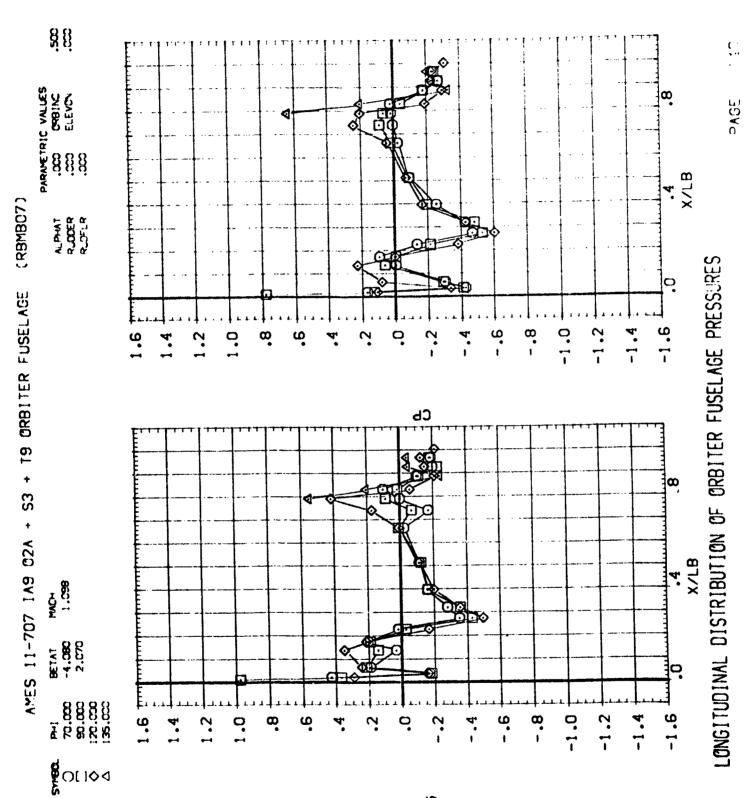
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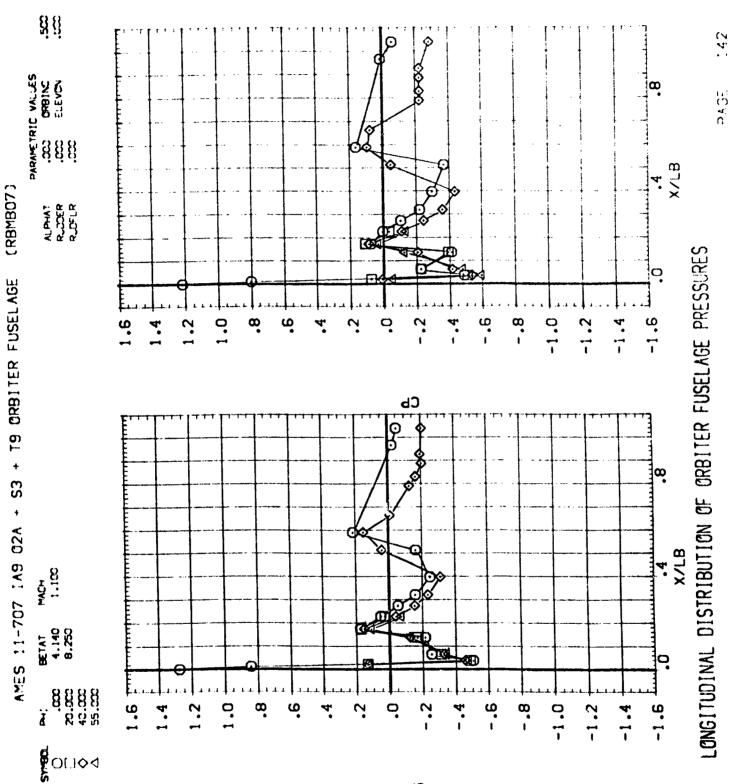
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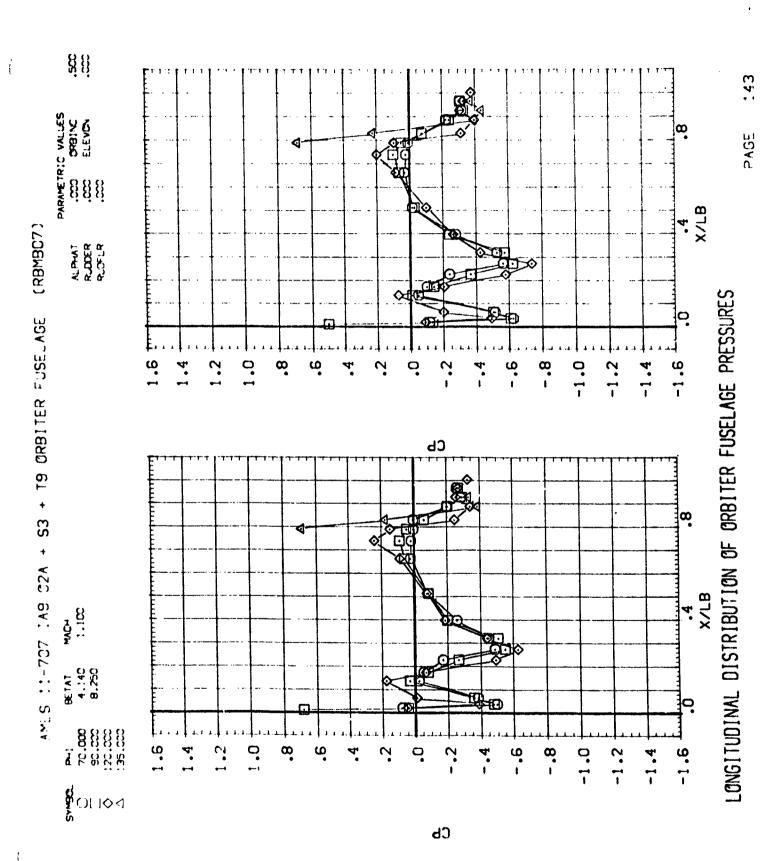
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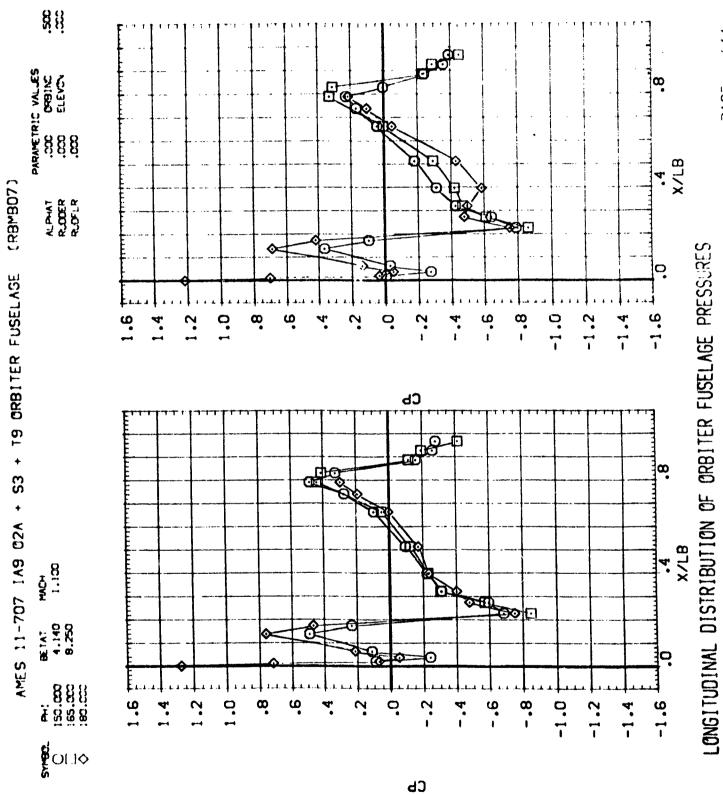
LONGITUDINAL DISTRIBUTION OF ORBITER FUSELAGE PRESSURES

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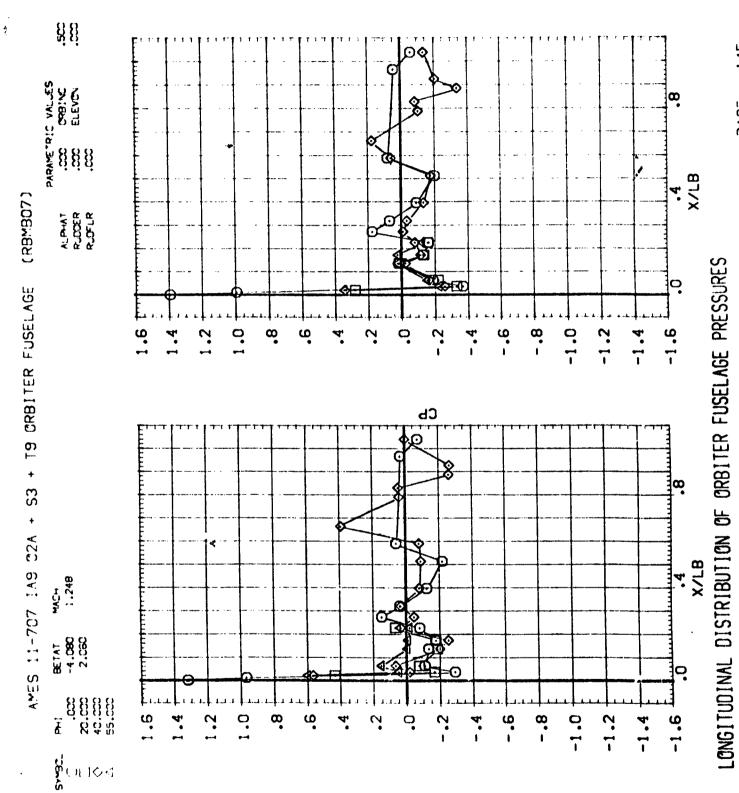




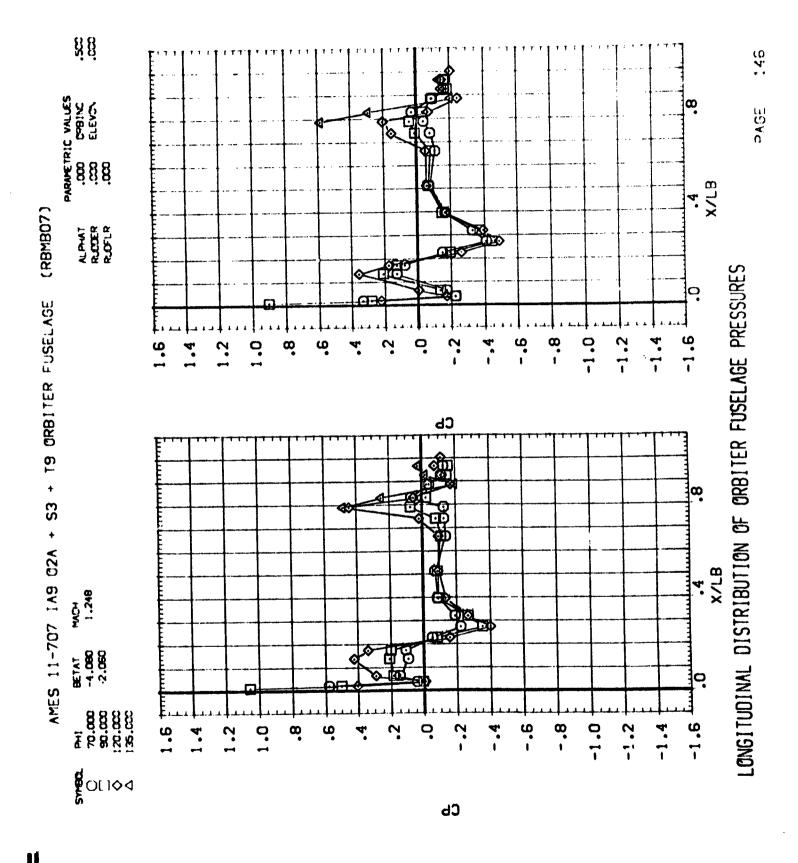


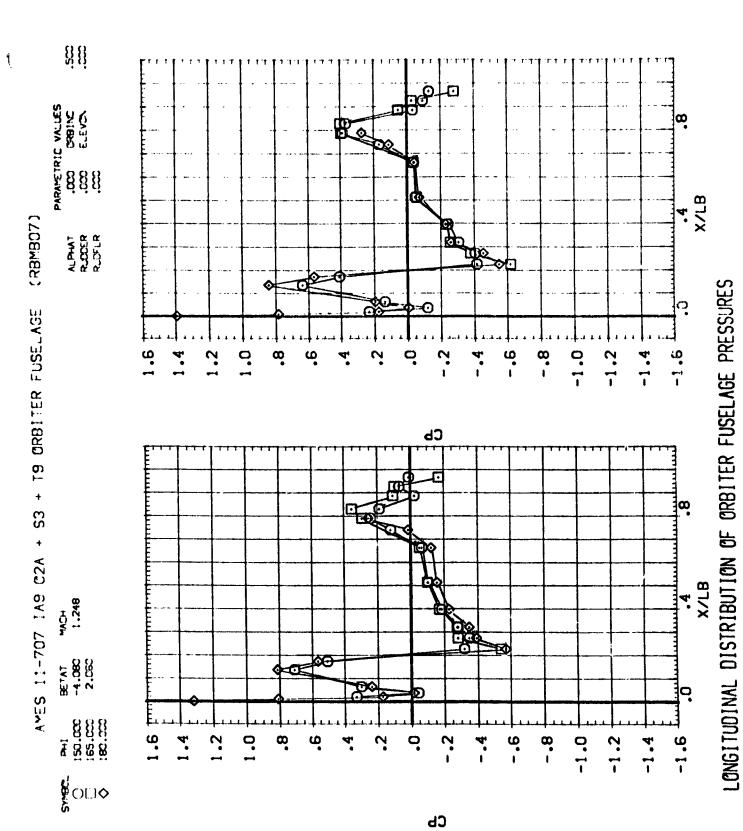
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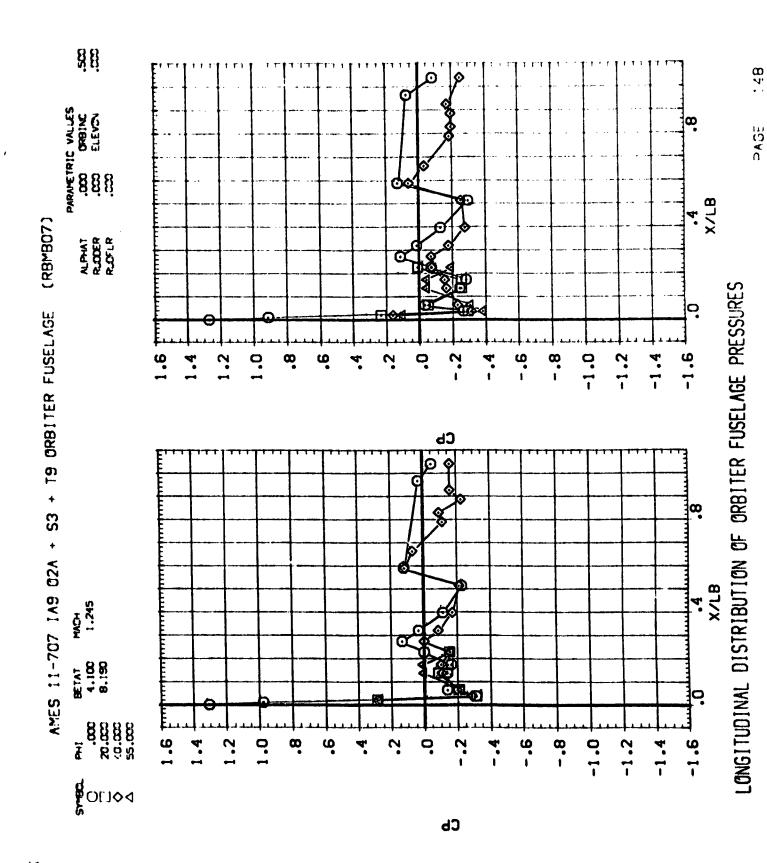


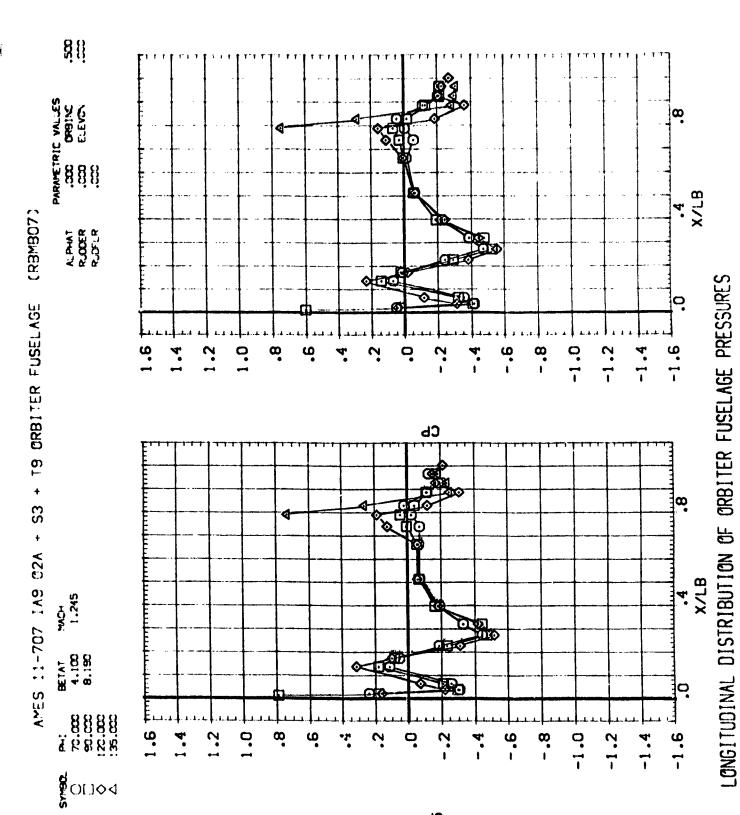
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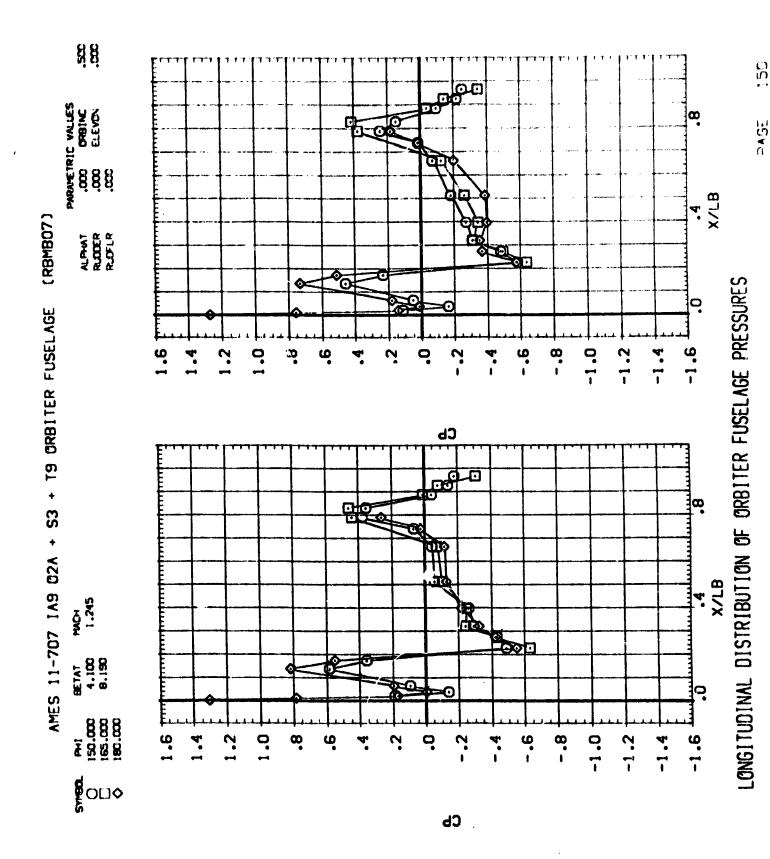


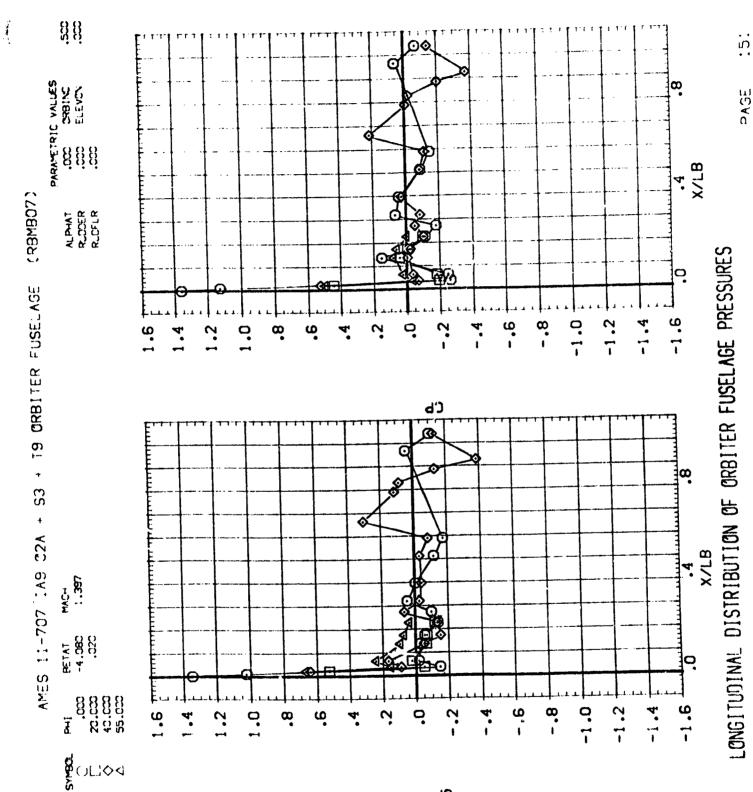


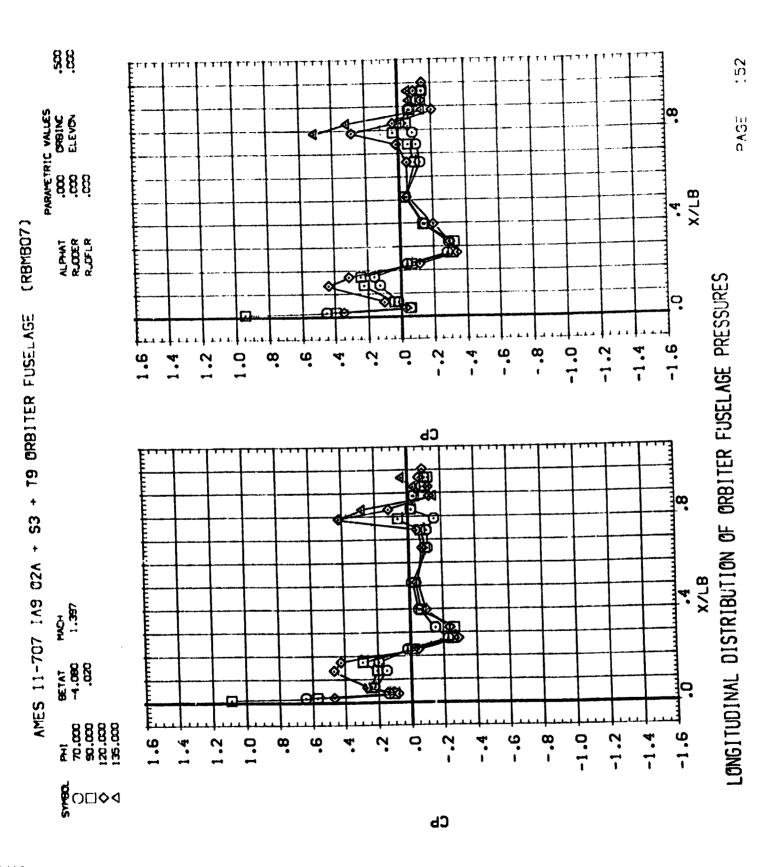
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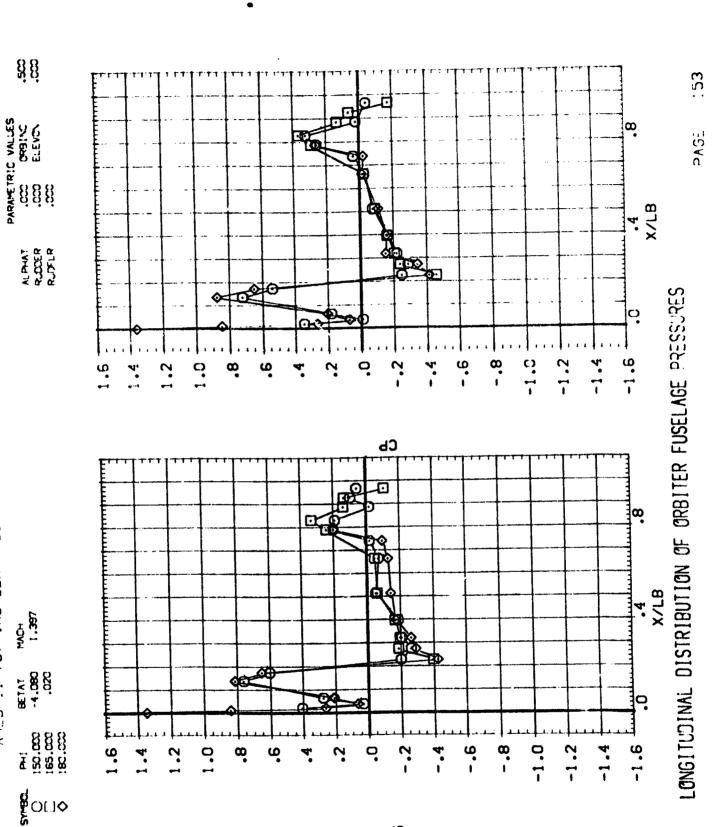
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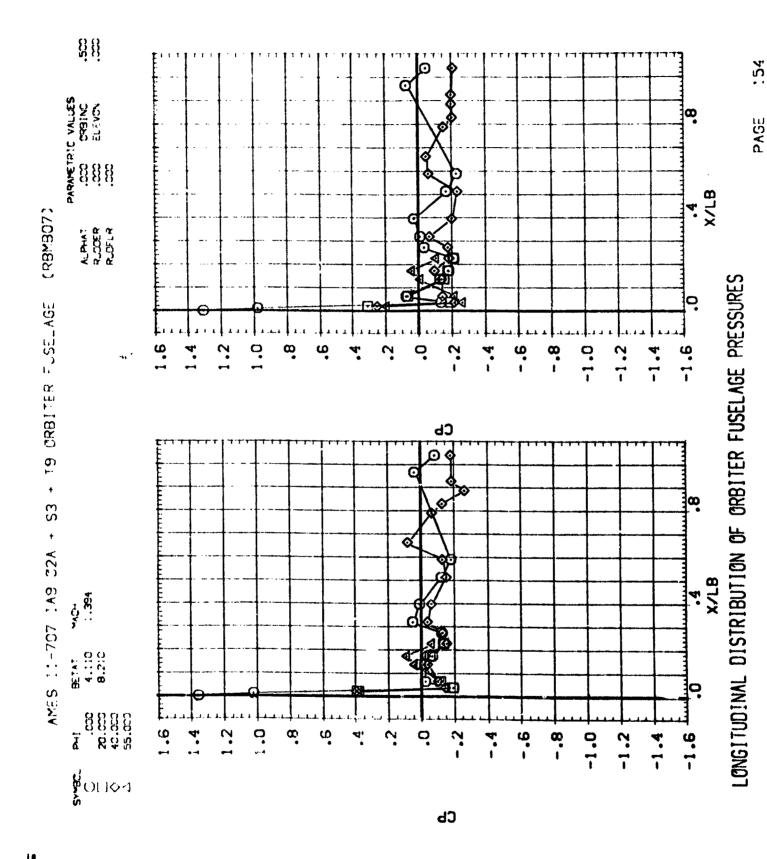
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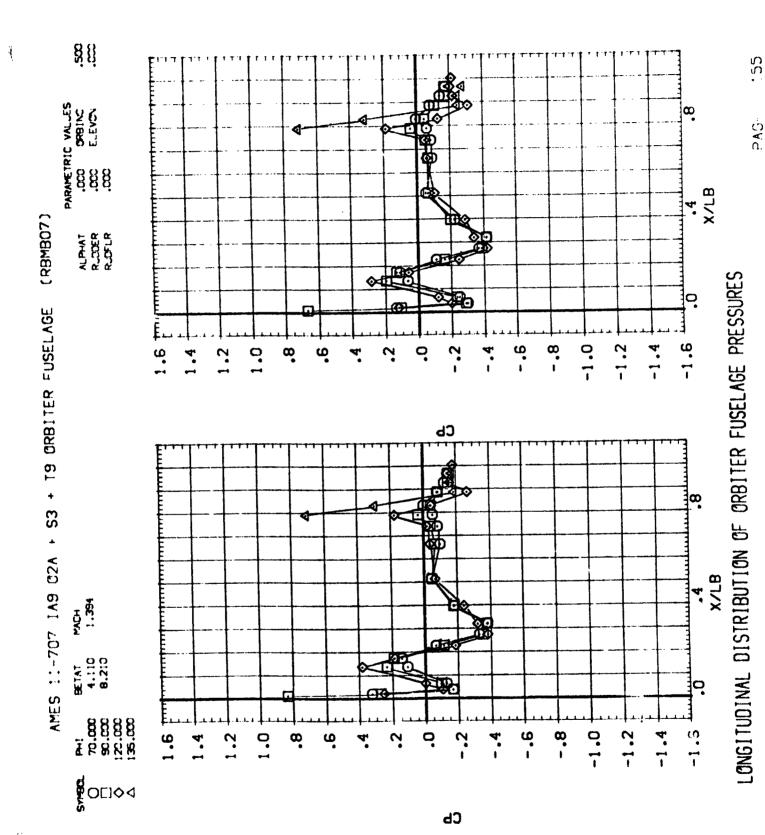
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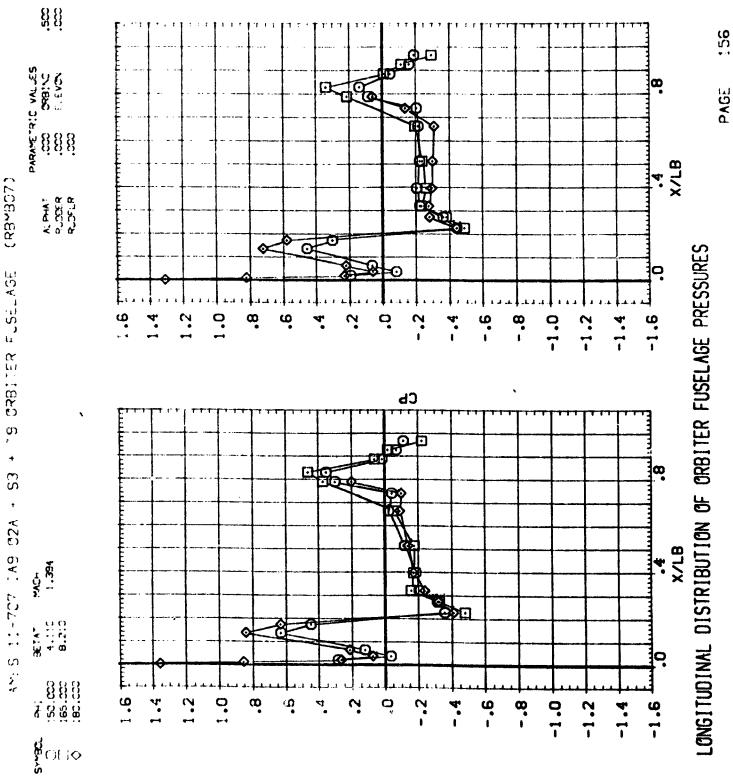
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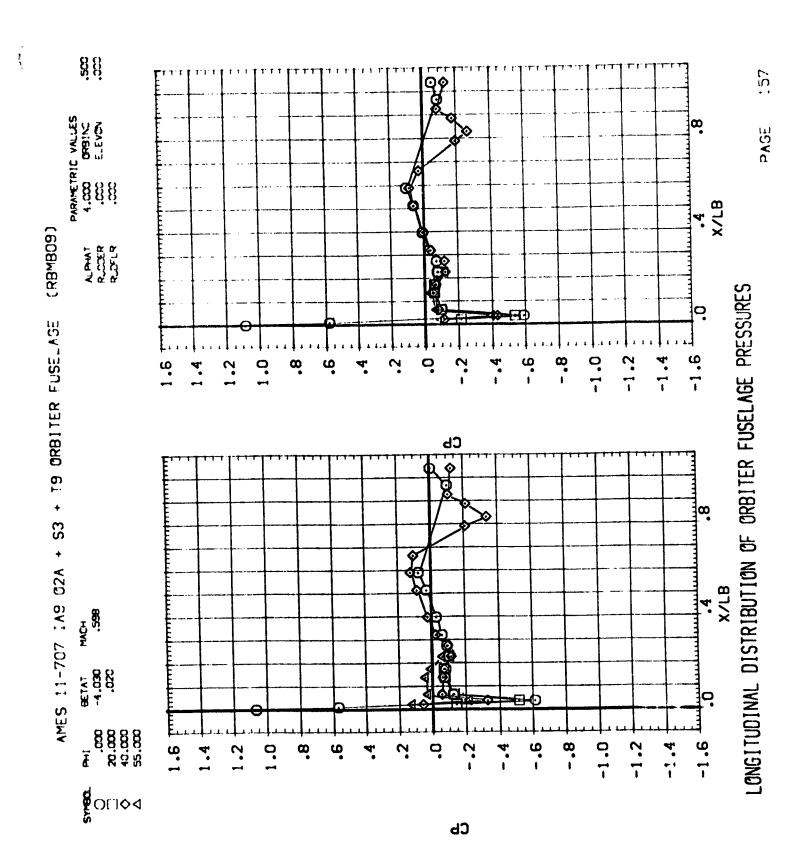
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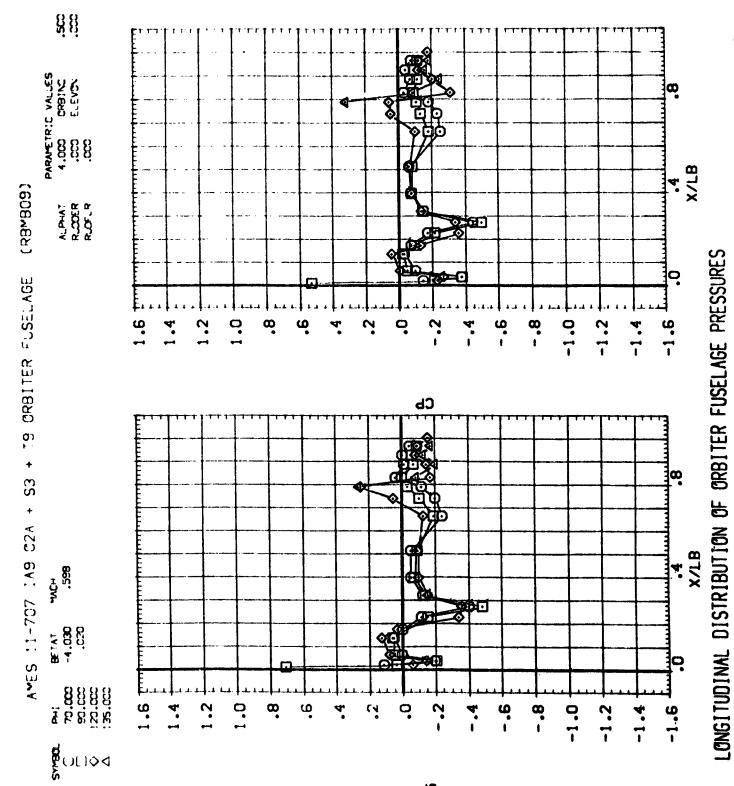
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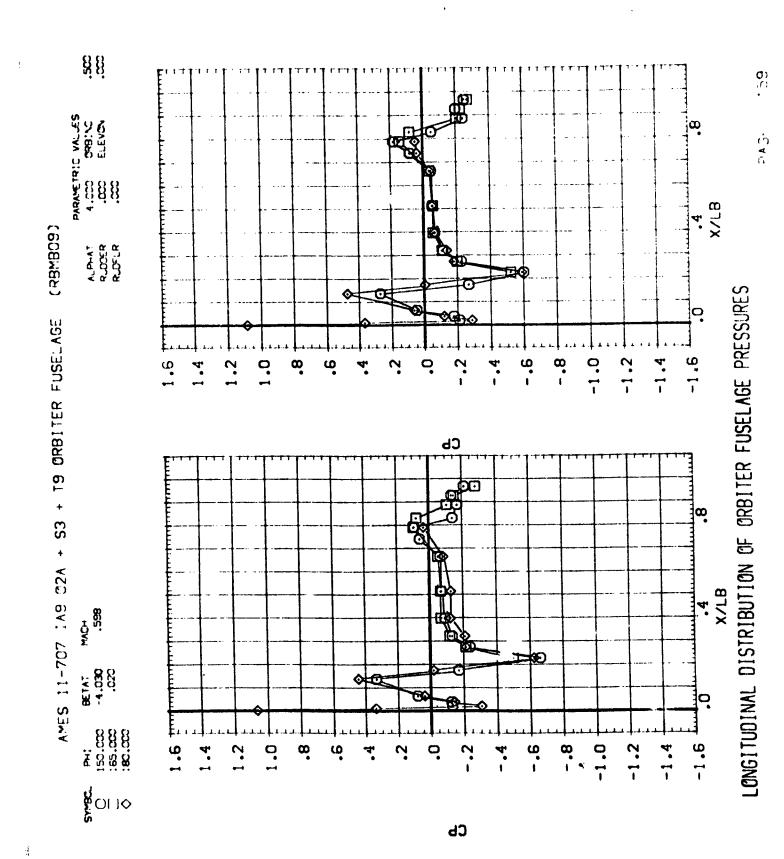


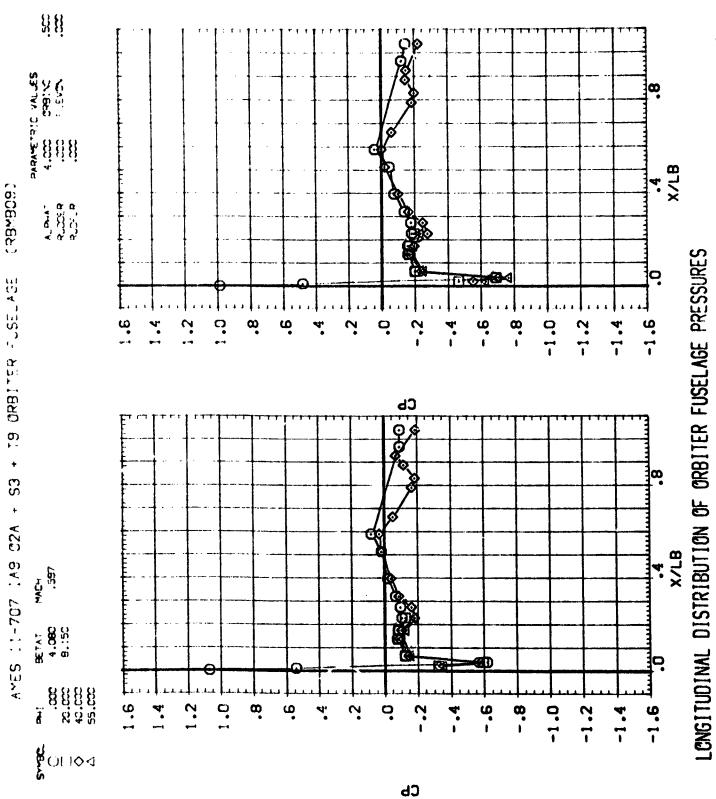




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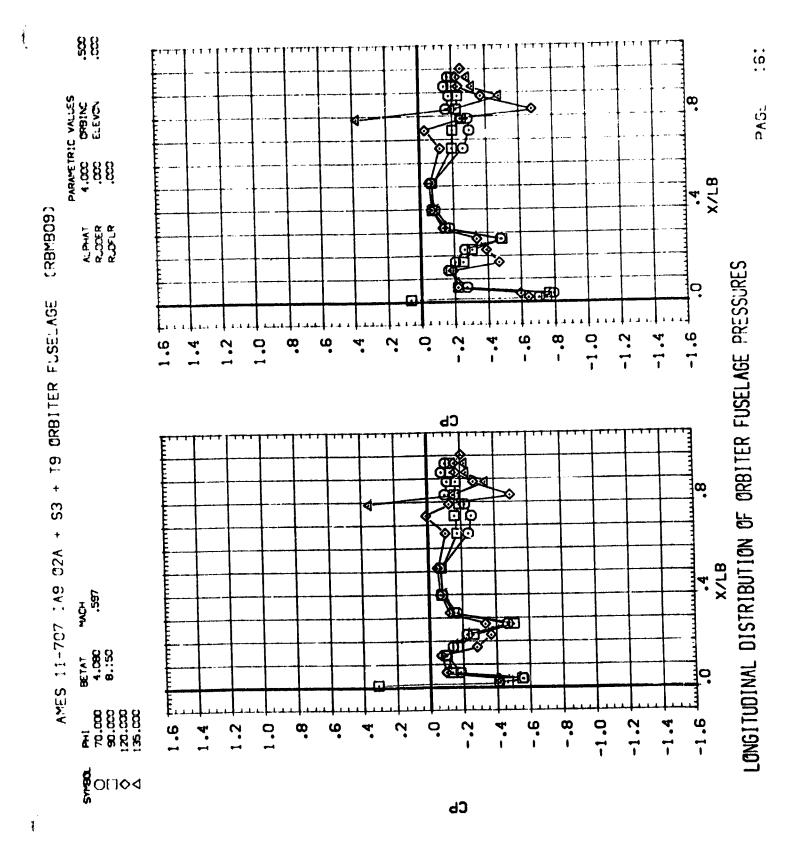
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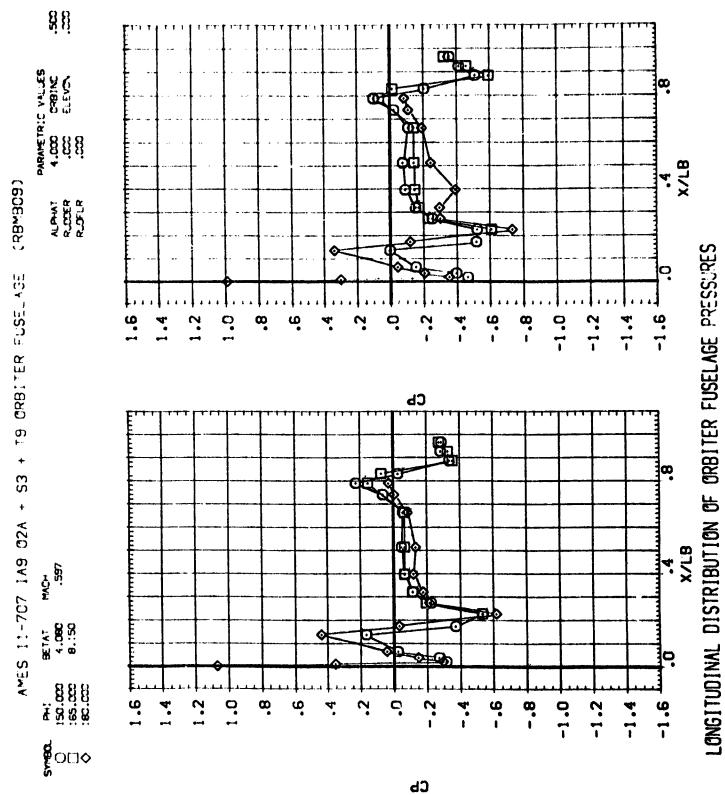




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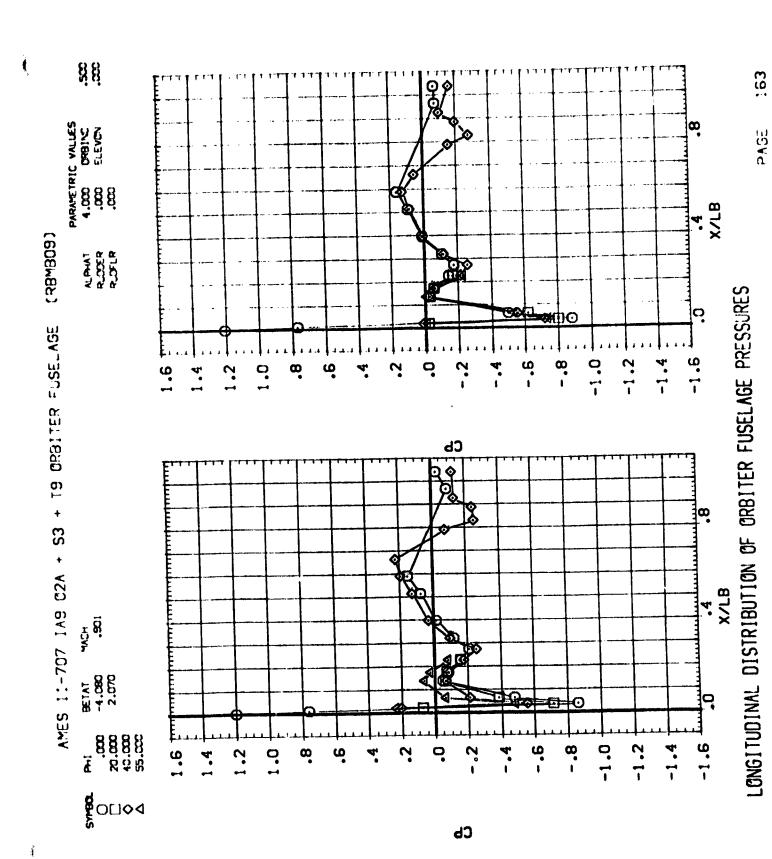
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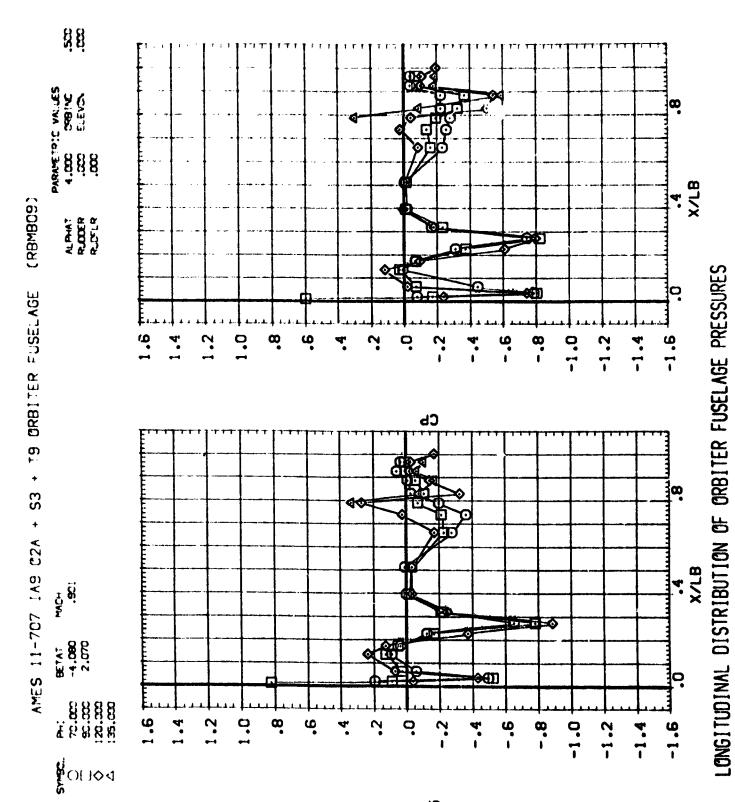




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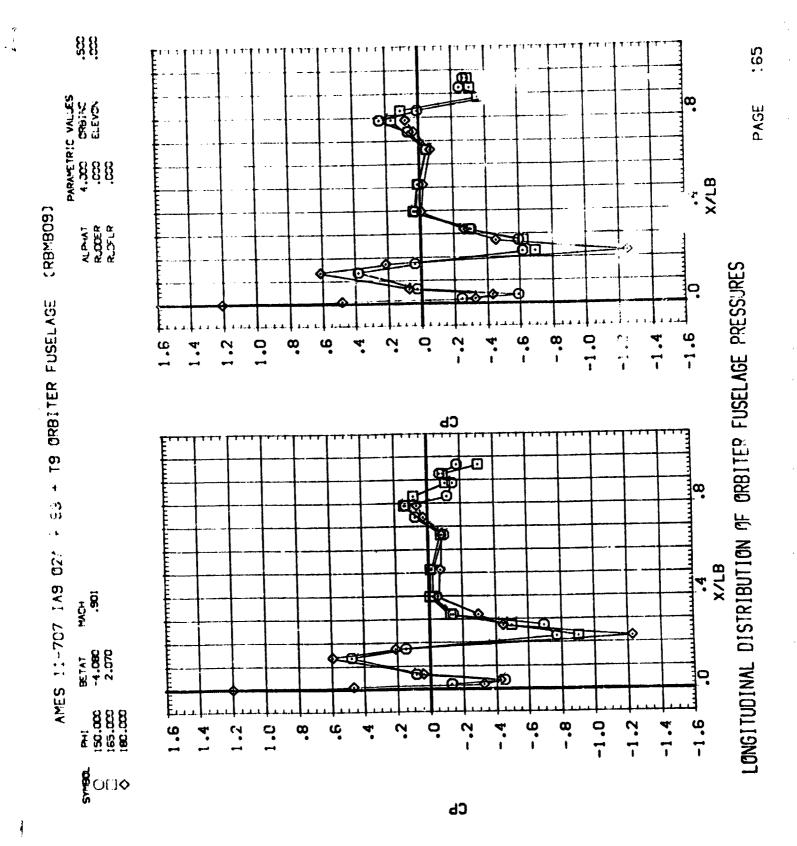
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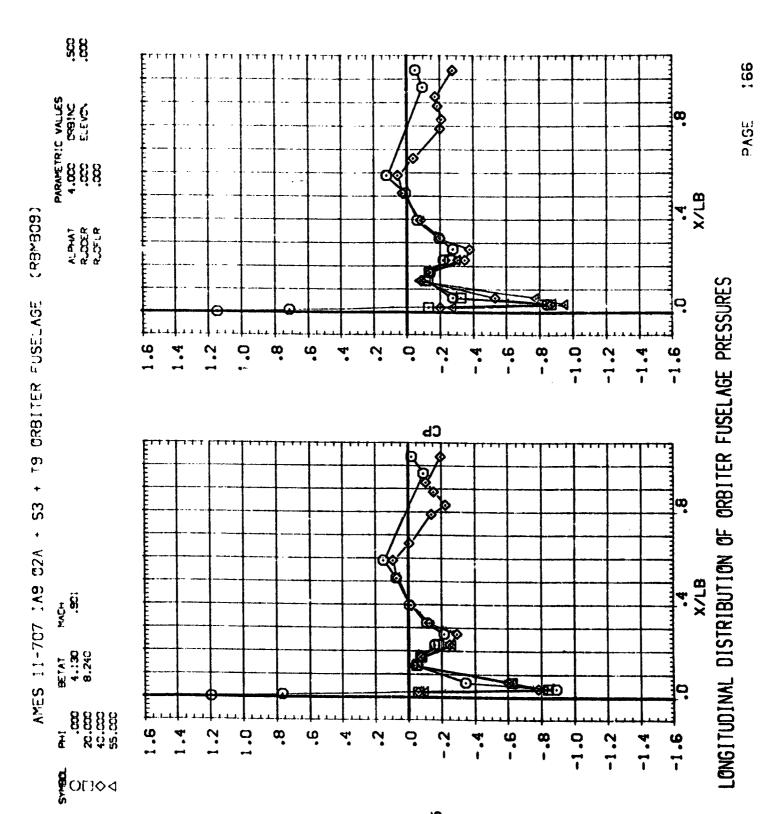


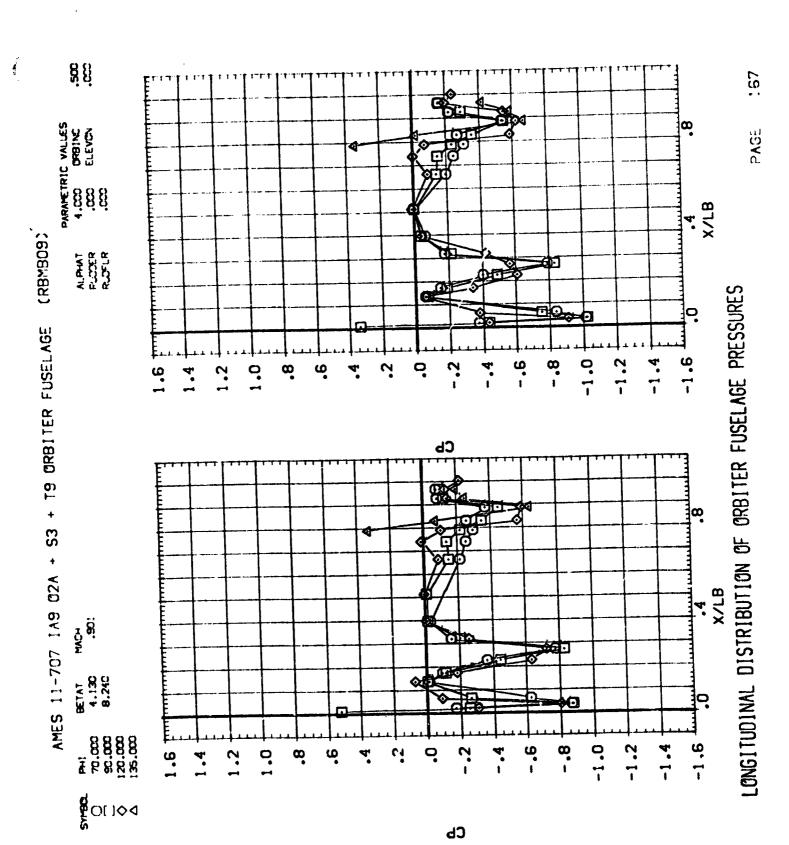


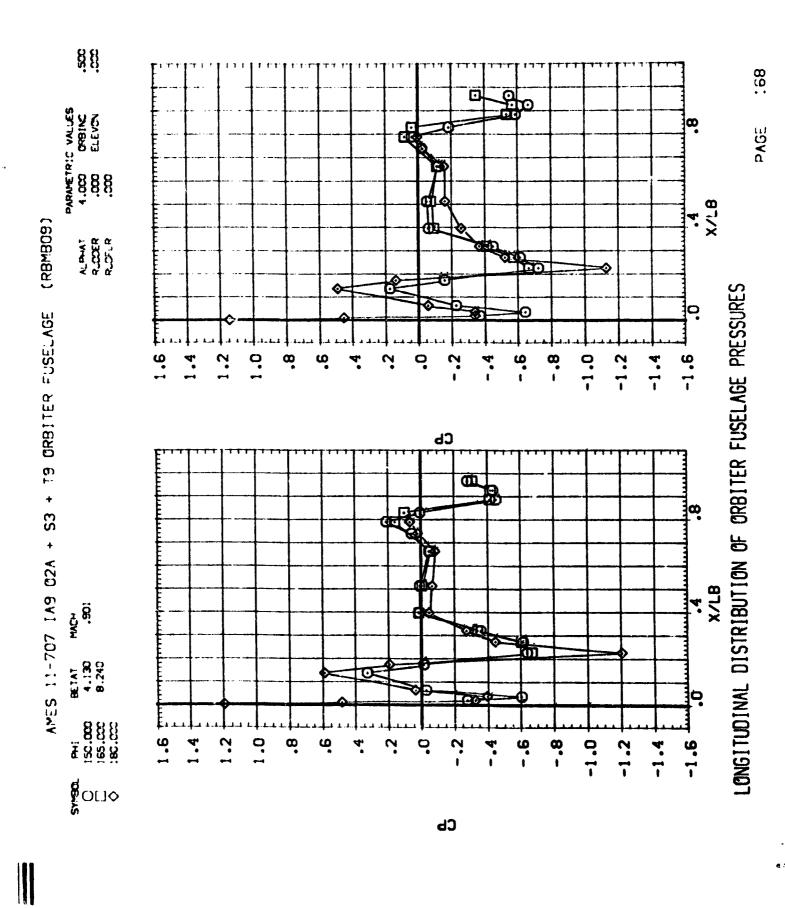
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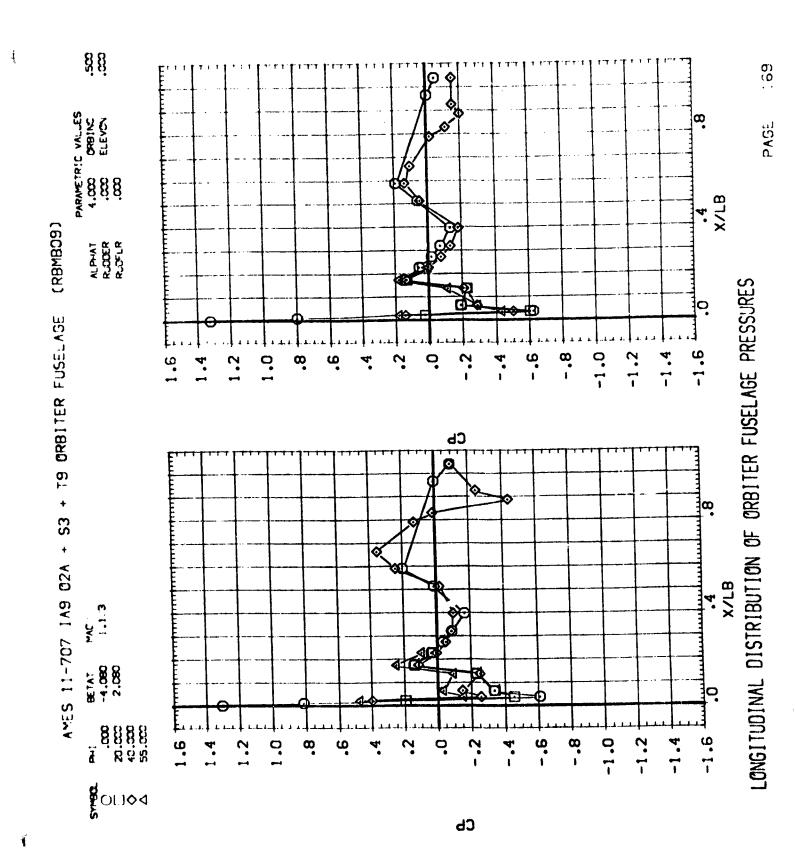
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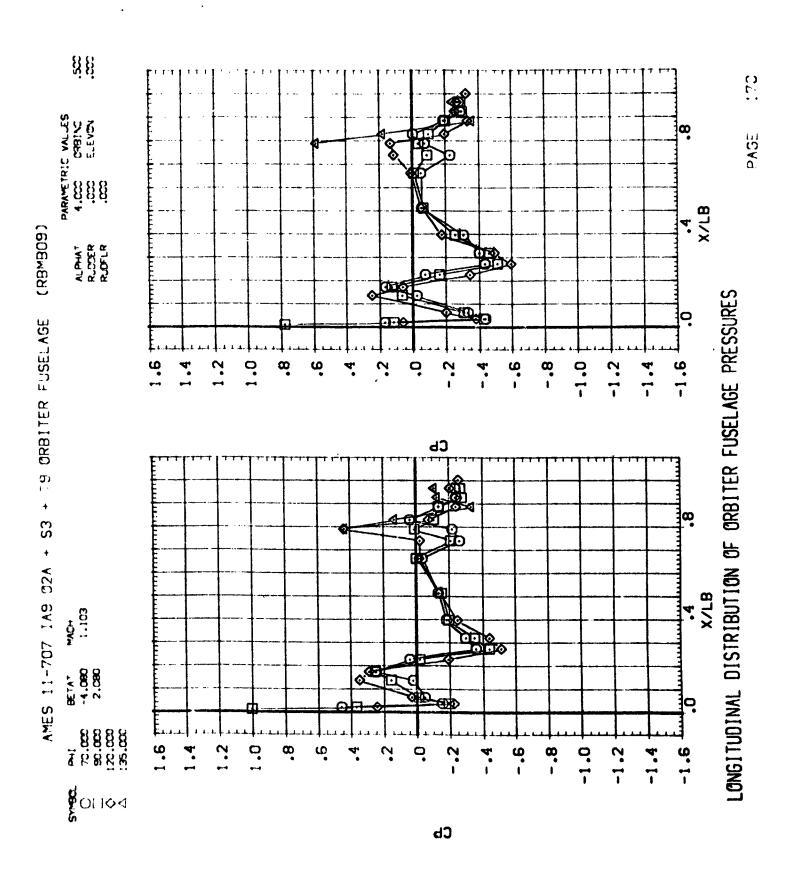


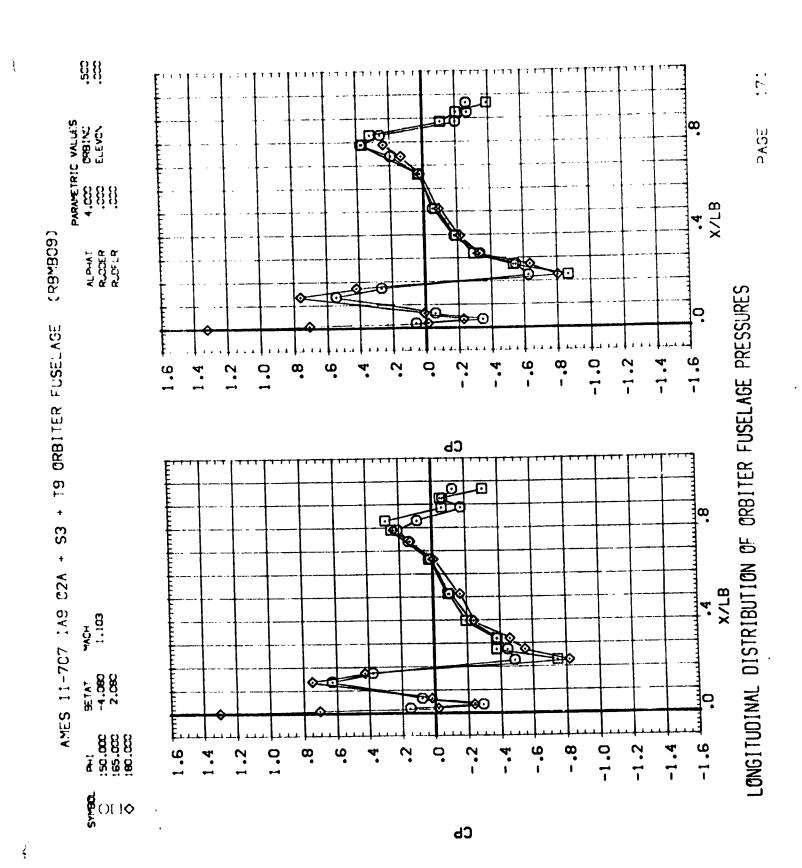




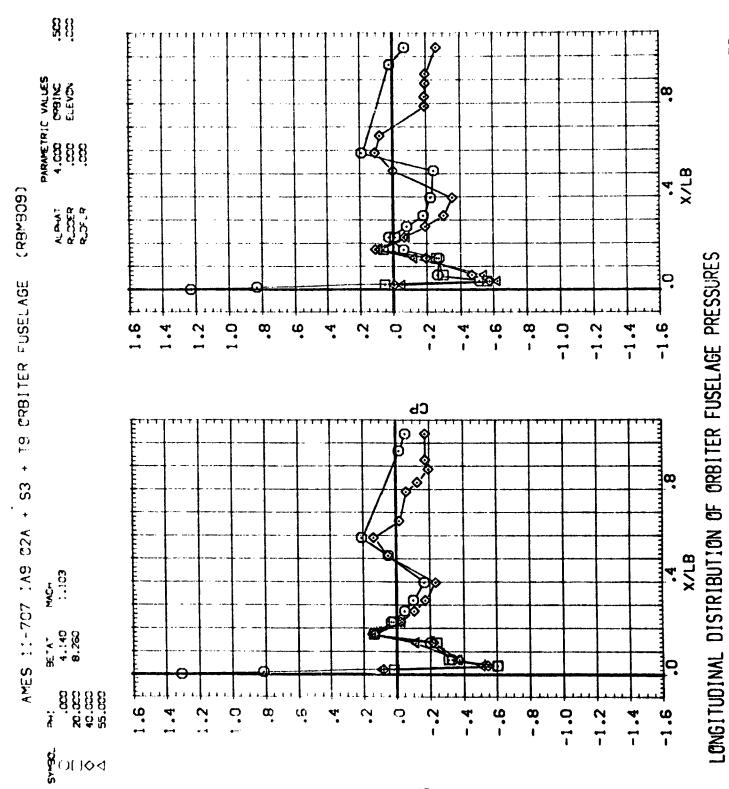


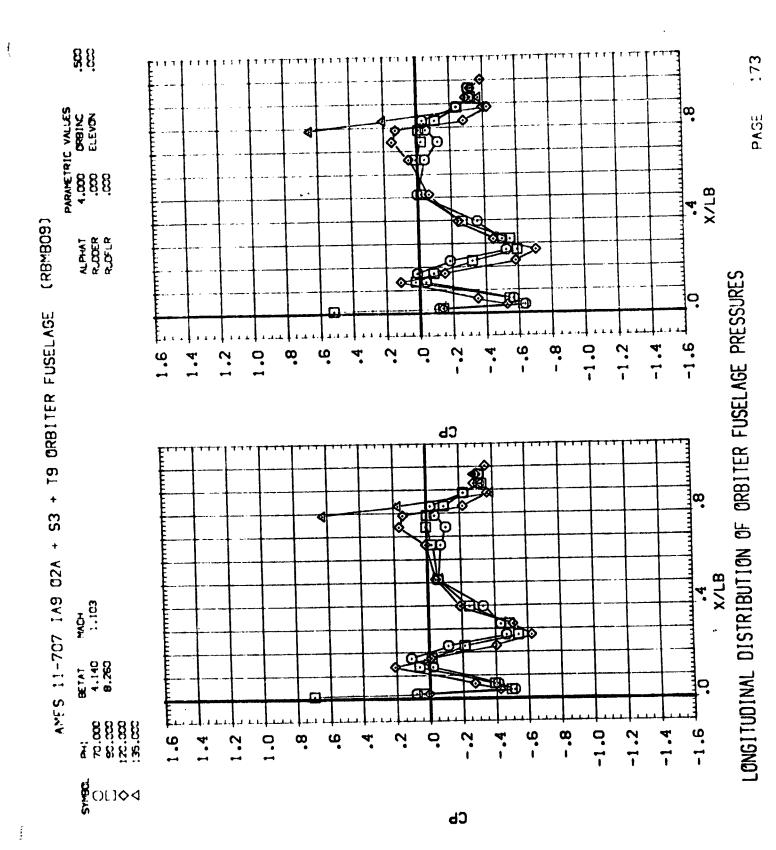


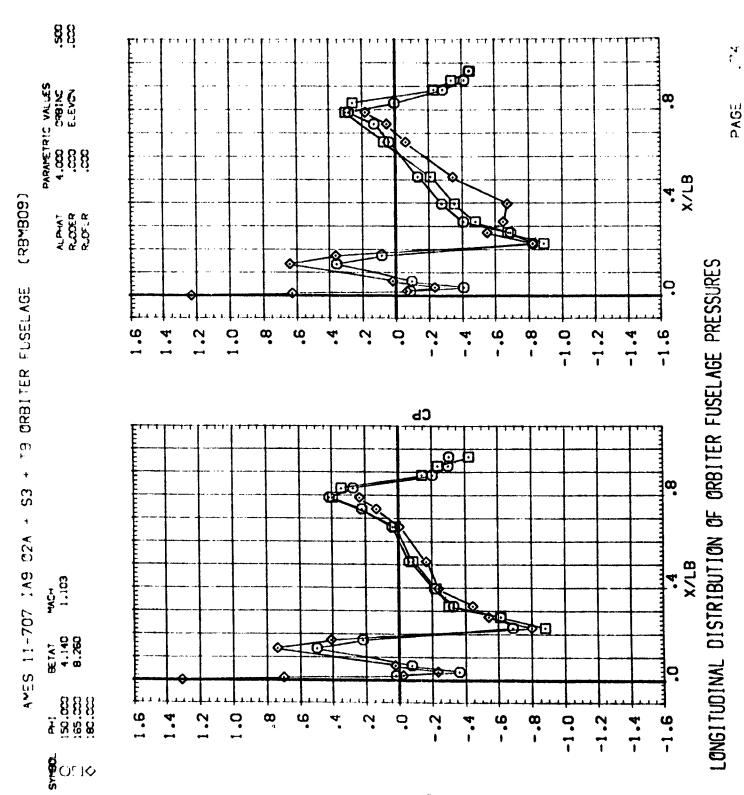


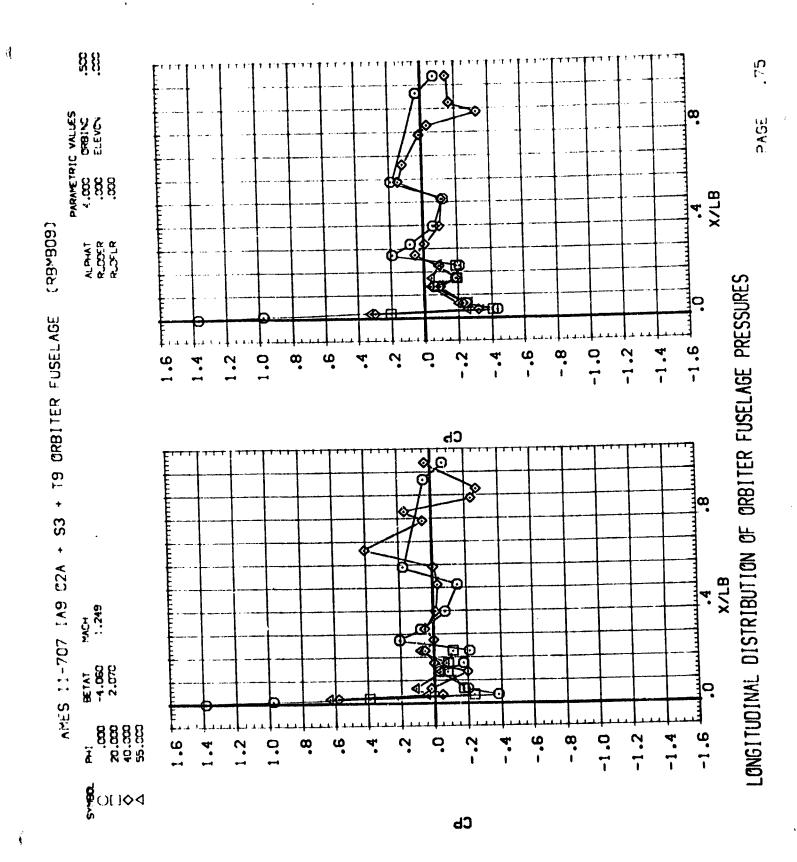


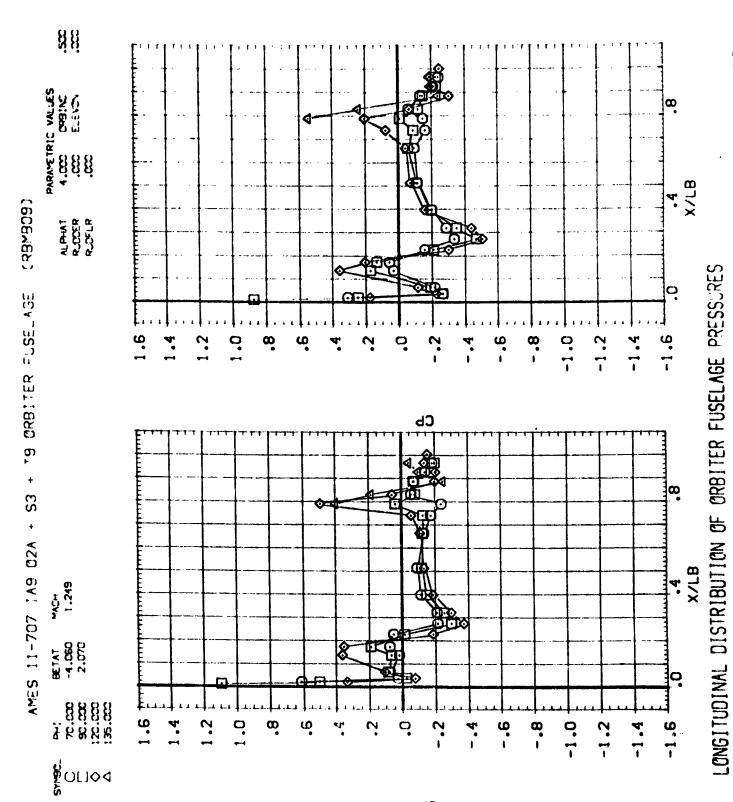




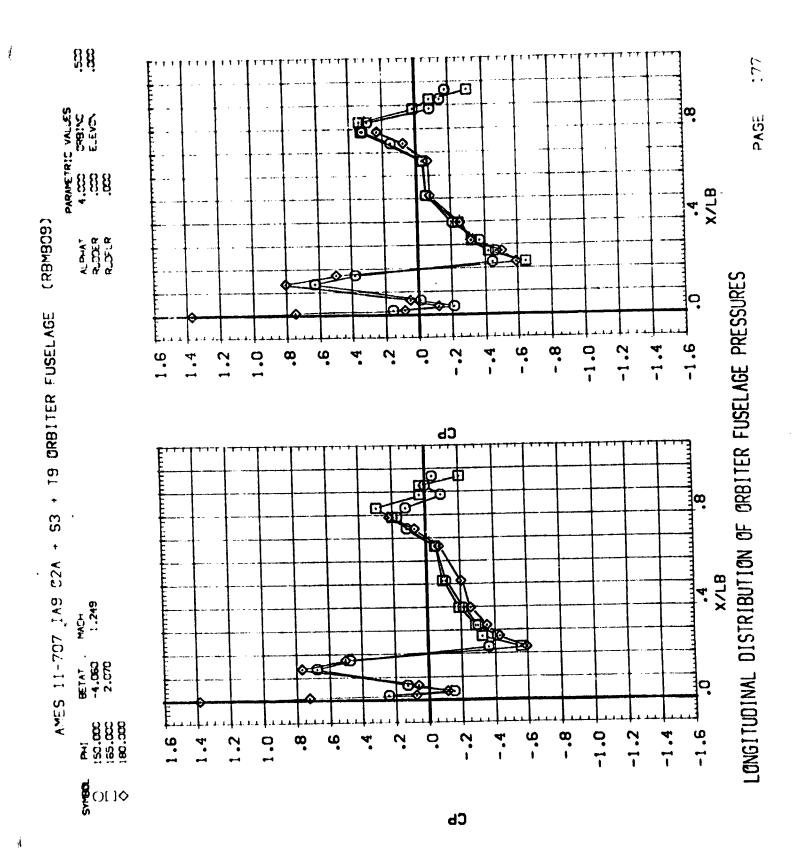




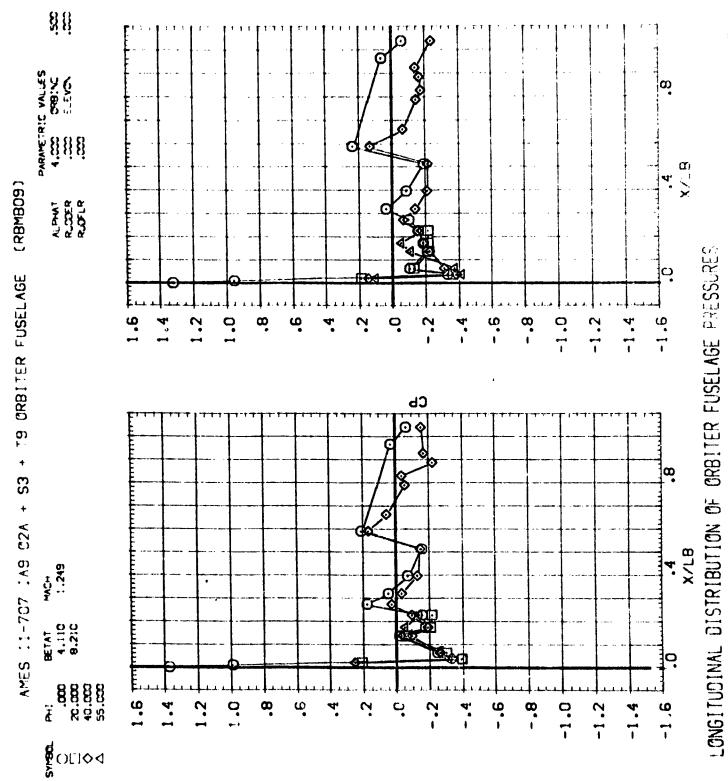




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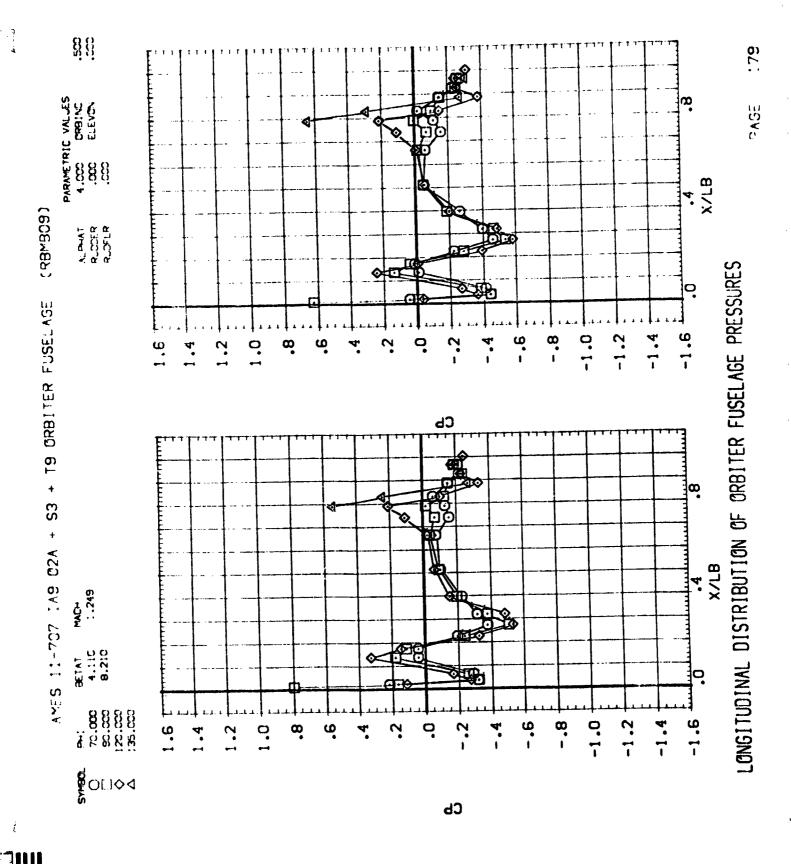


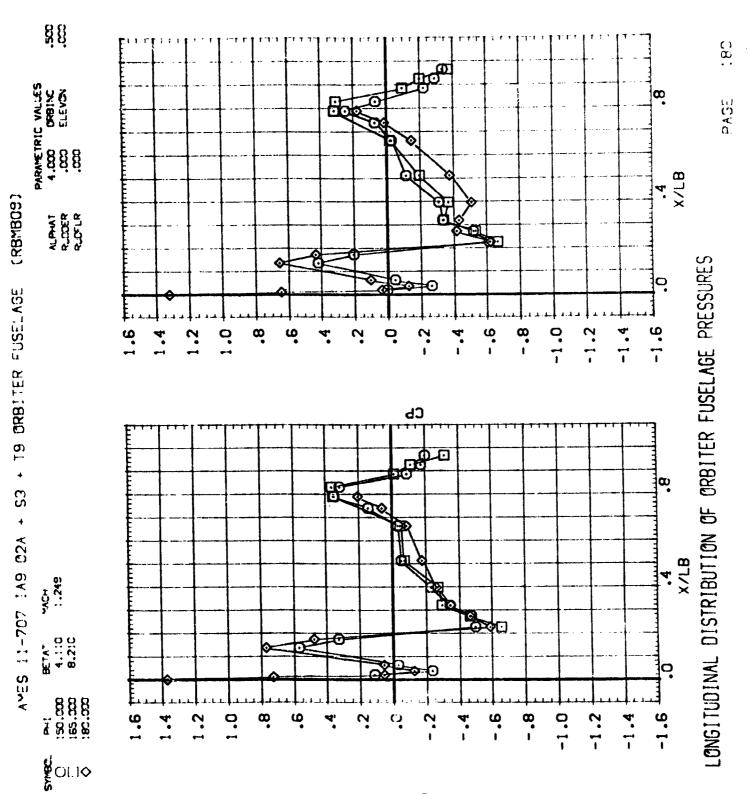
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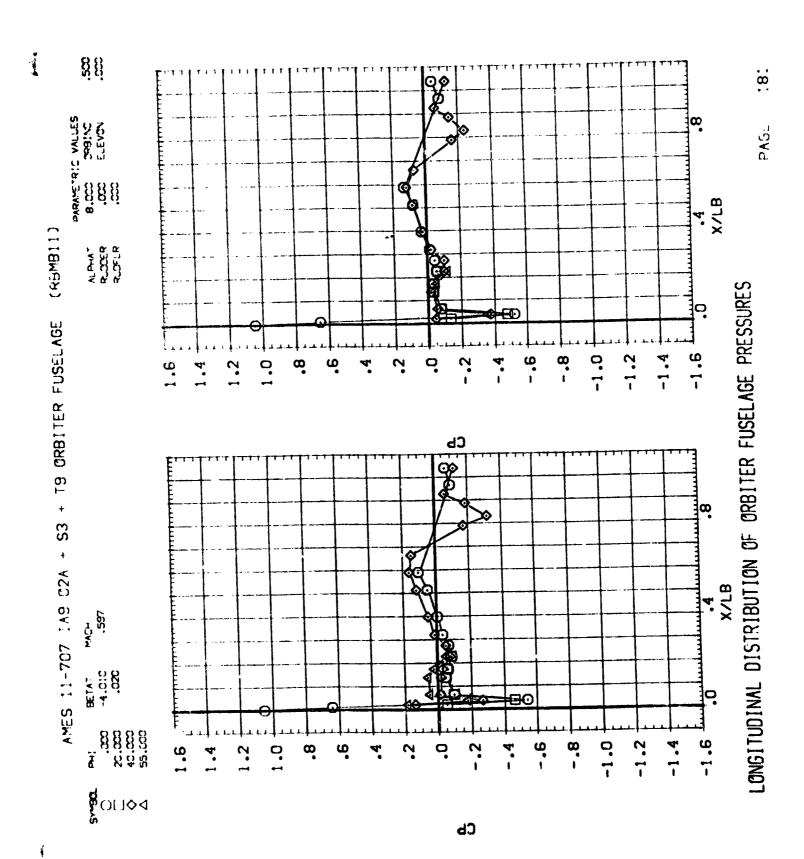


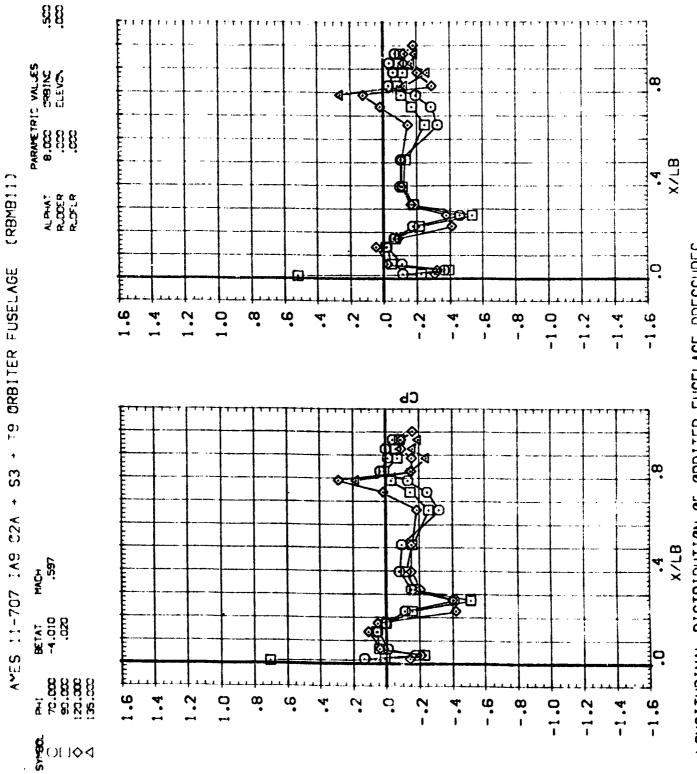
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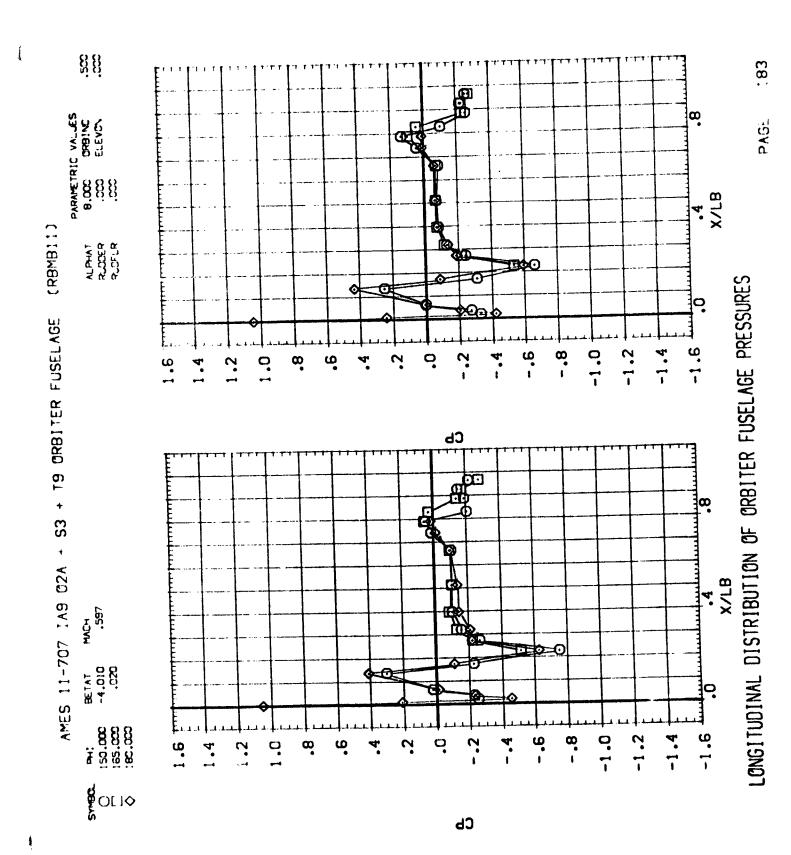


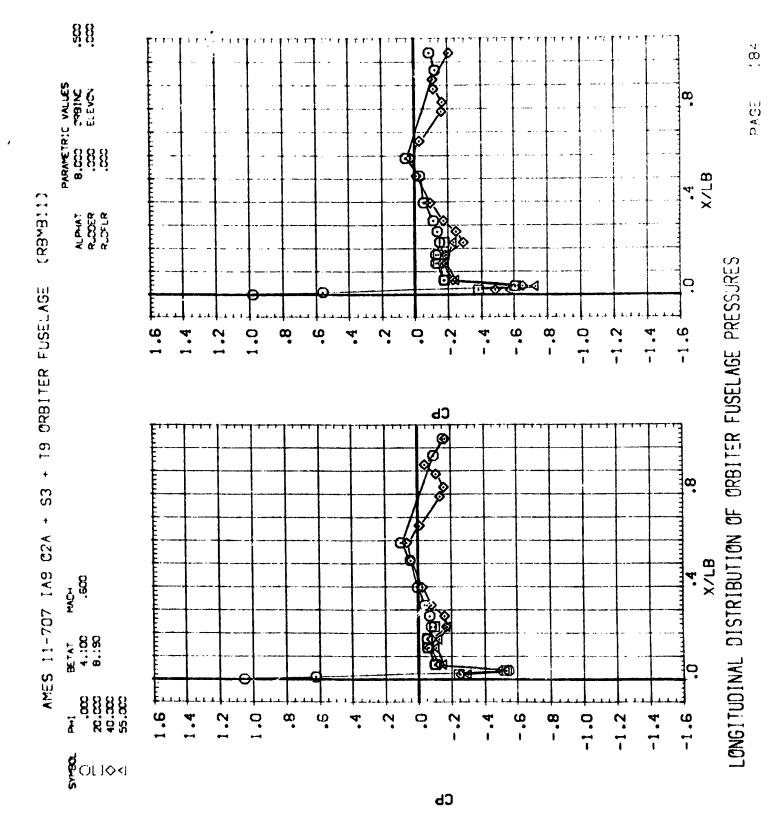


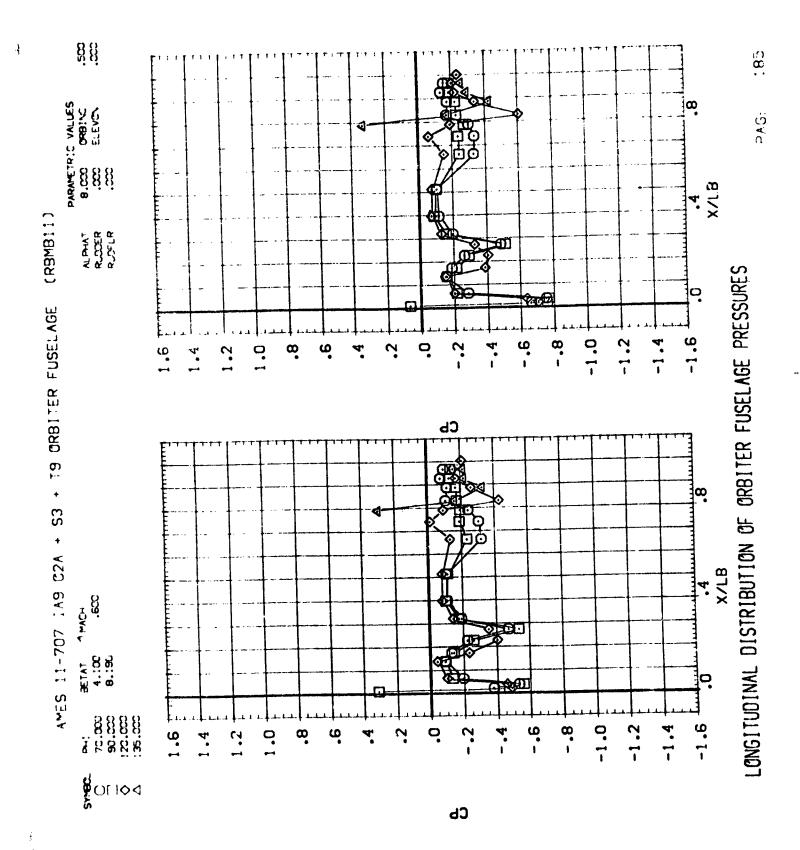


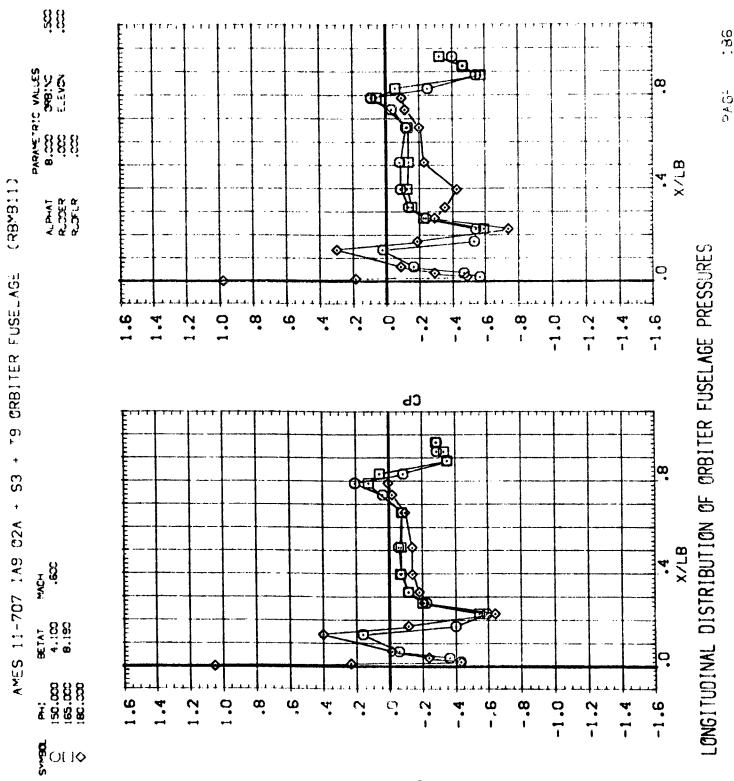
LONGITUDINAL DISTRIBUTION OF ORBITER FUSELAGE PRESSURES

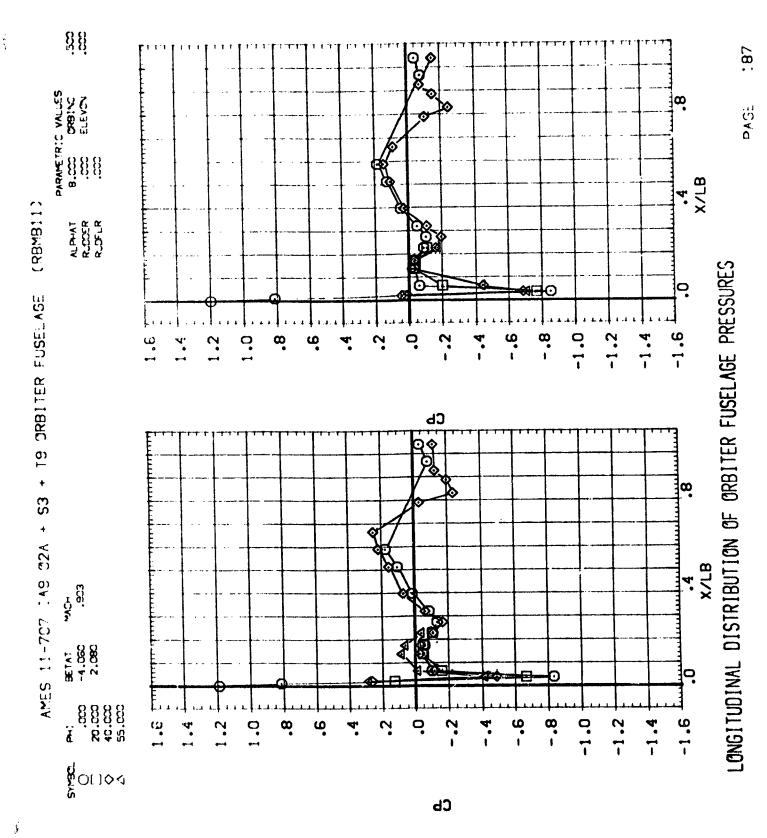
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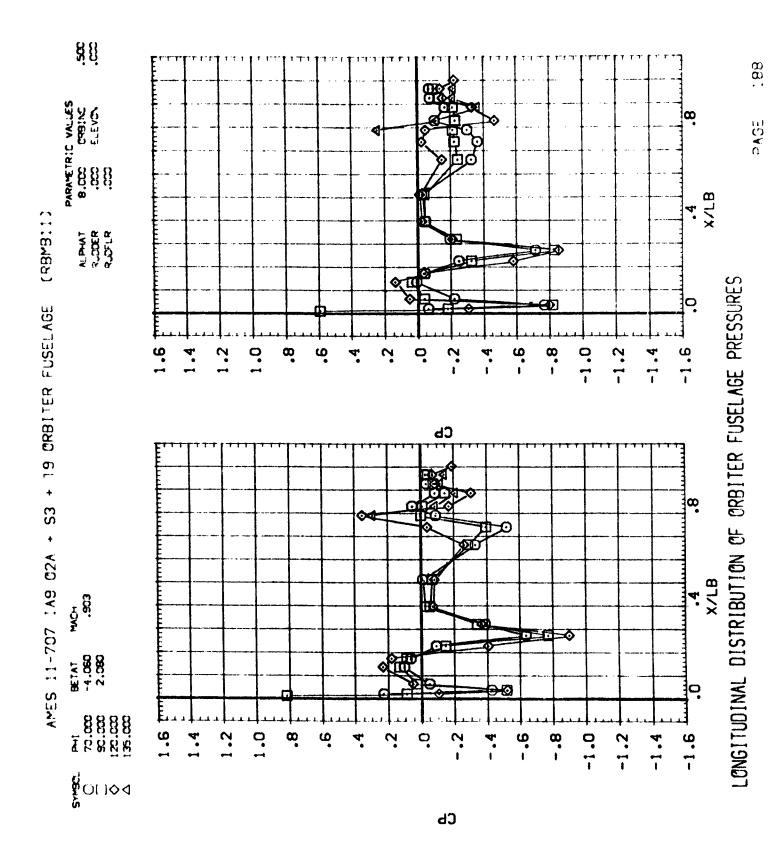


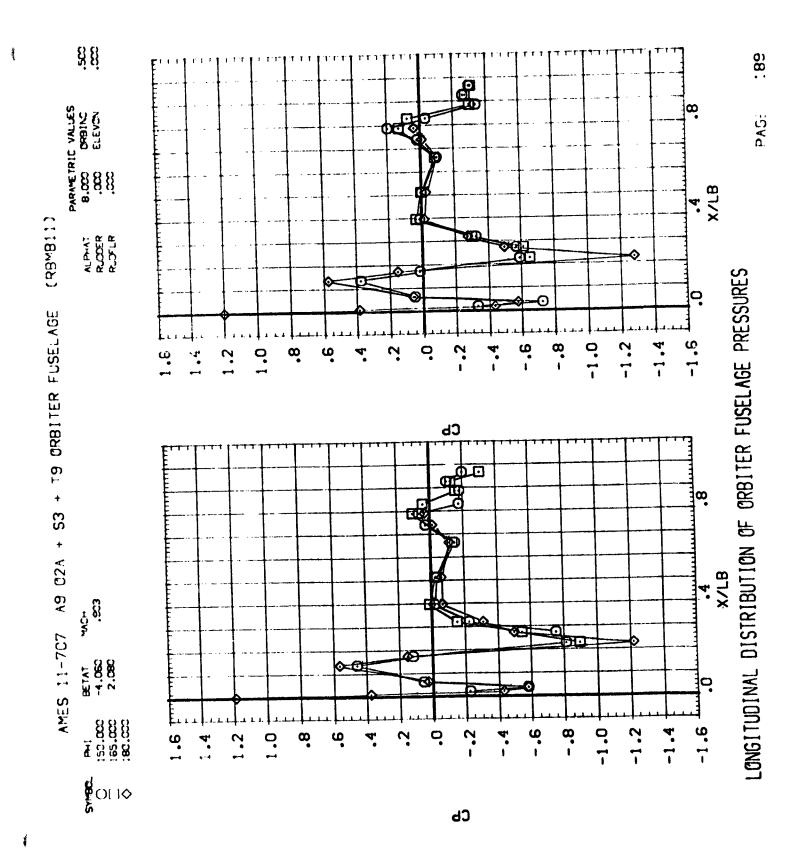


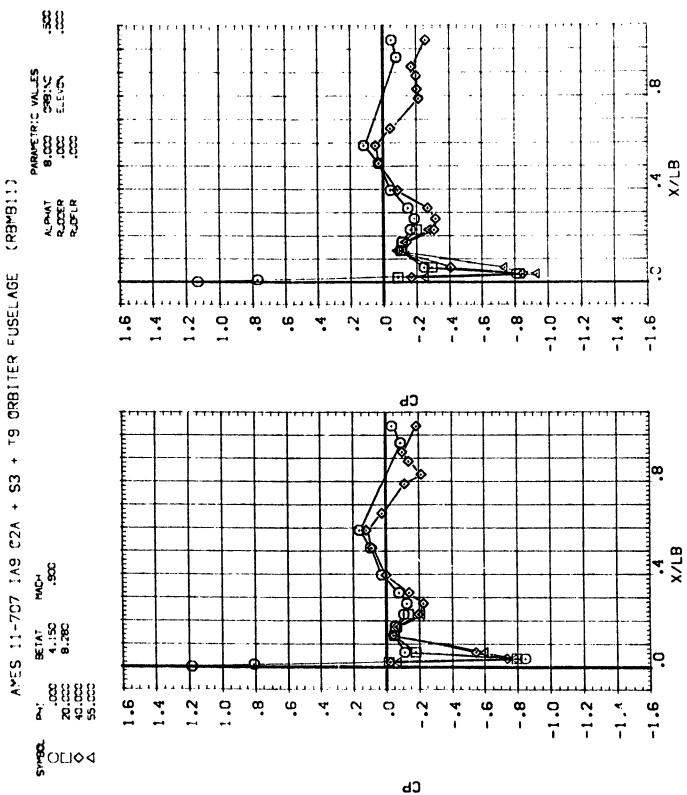








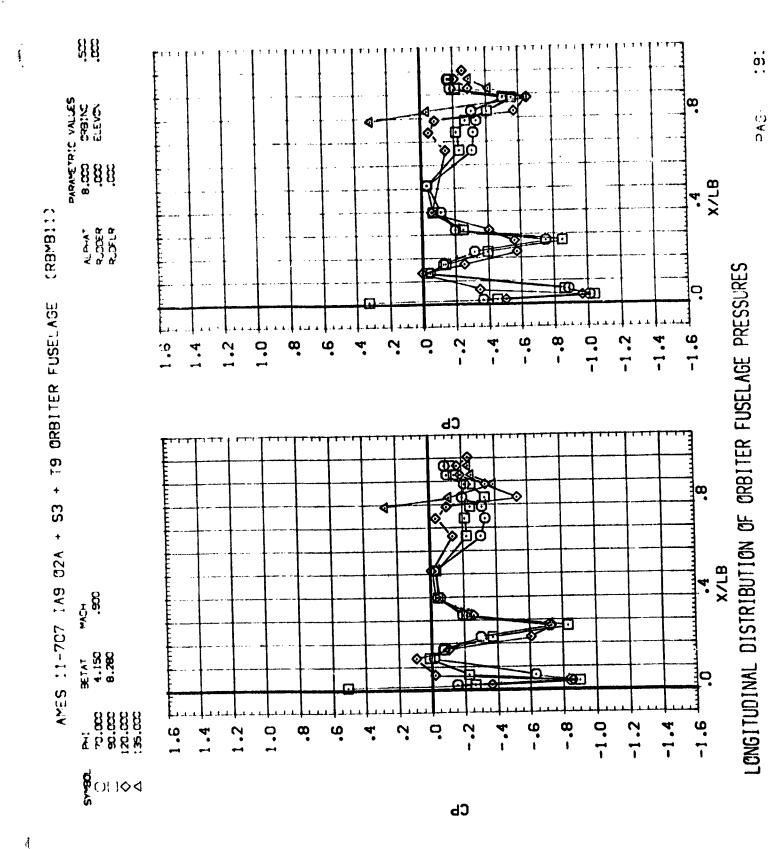


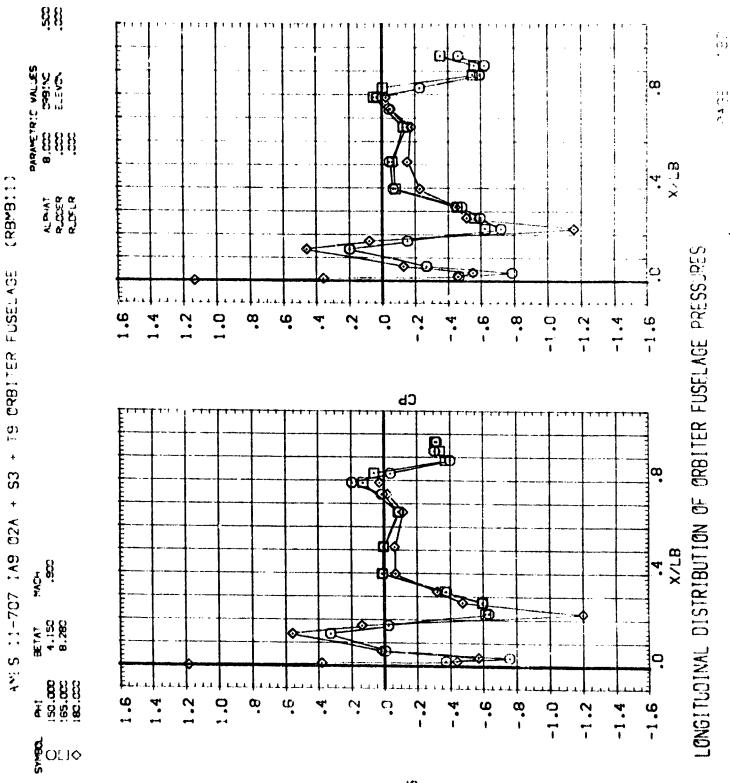


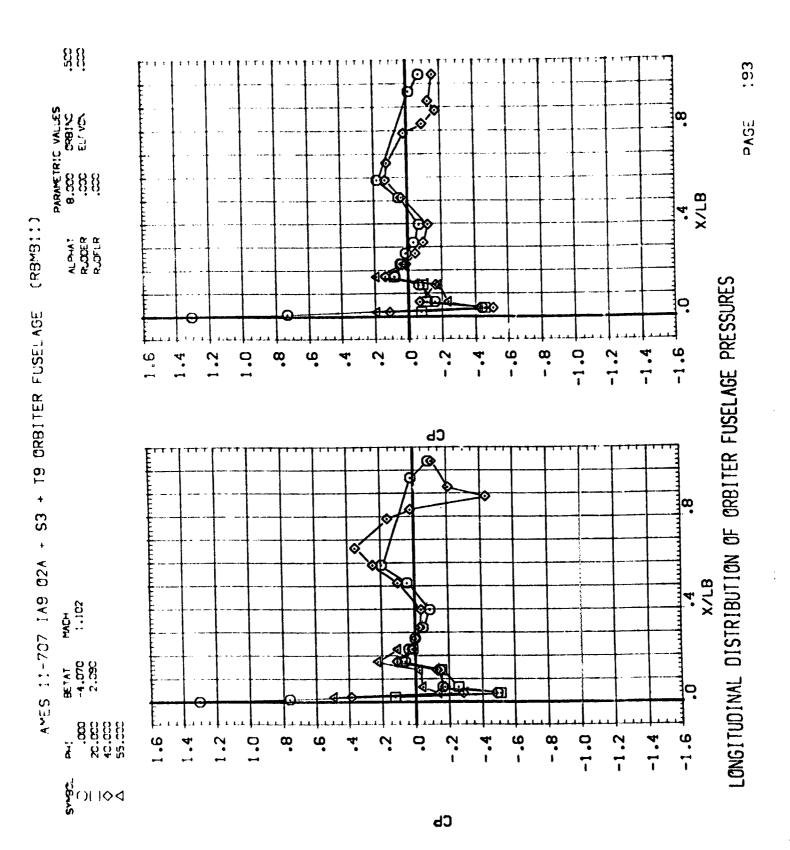
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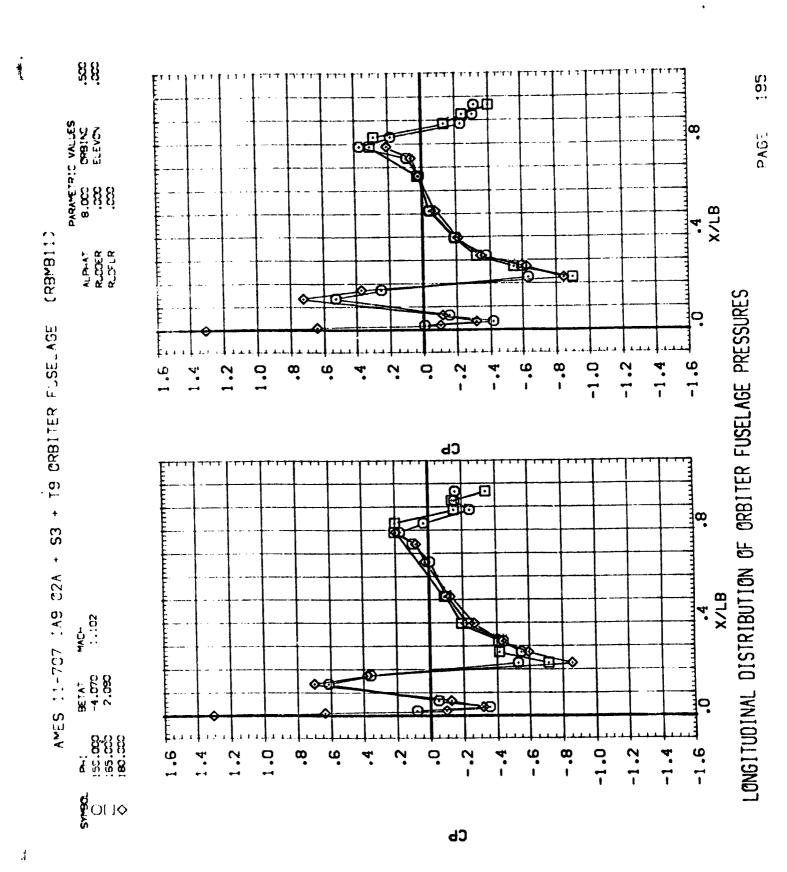
LONGITUDINAL DISTRIBUTION OF ORBITER FUSELAGE PRESSURES





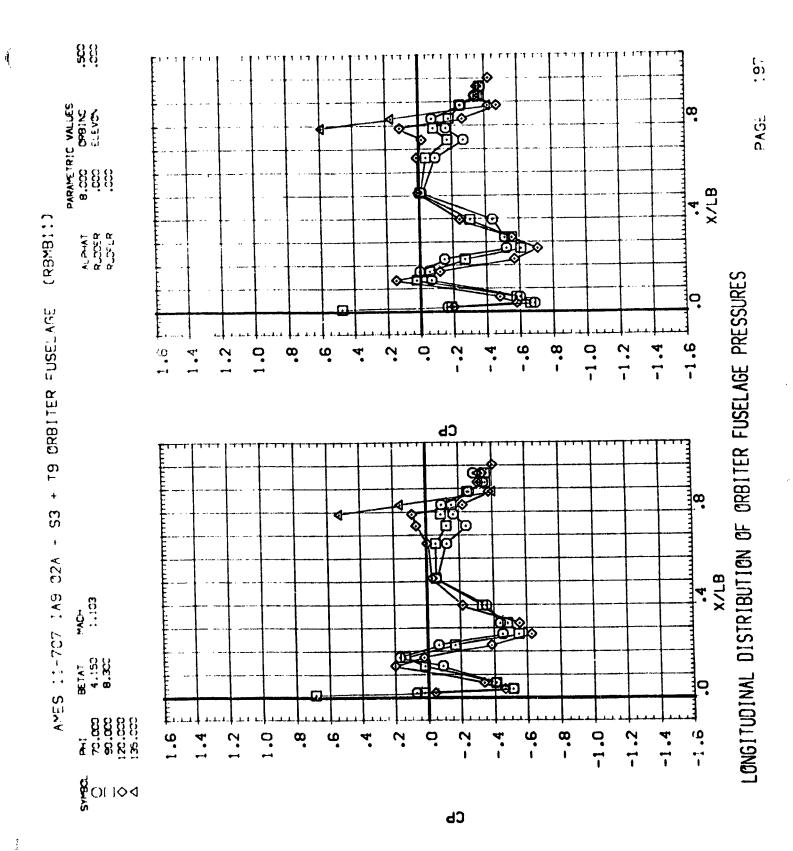


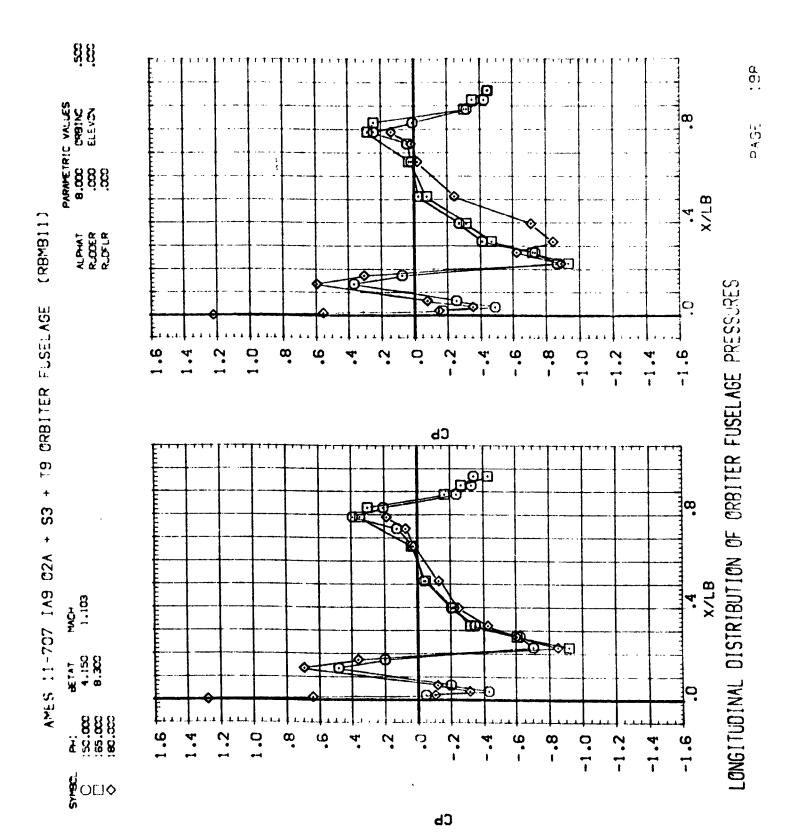
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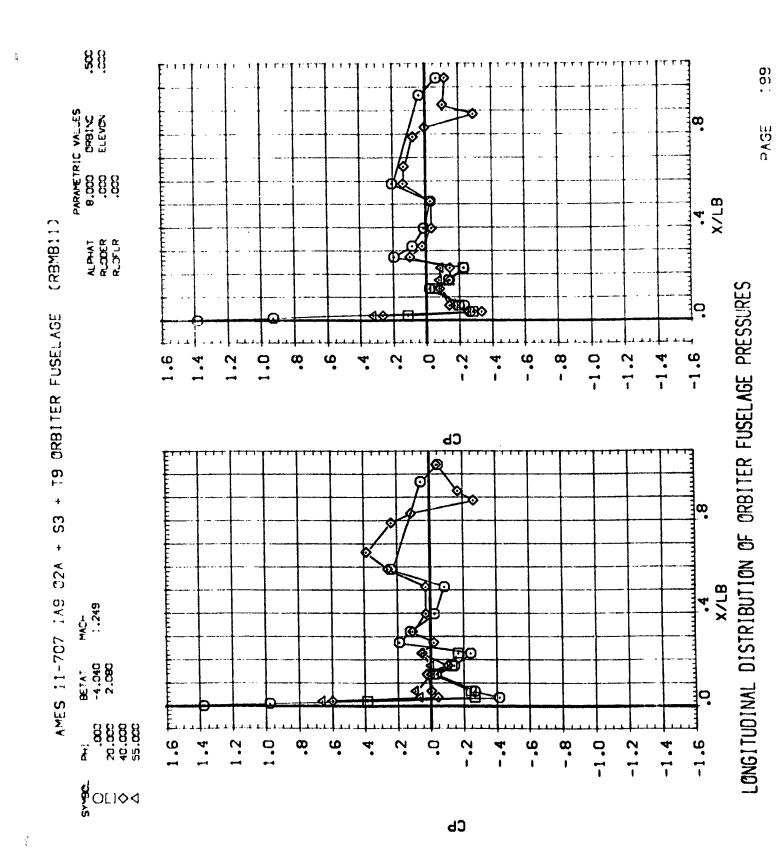


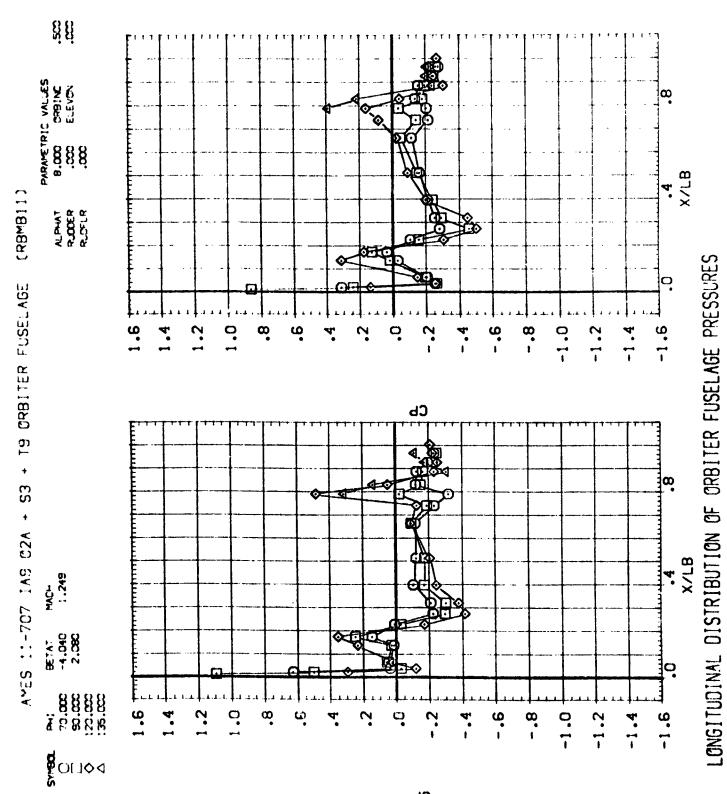
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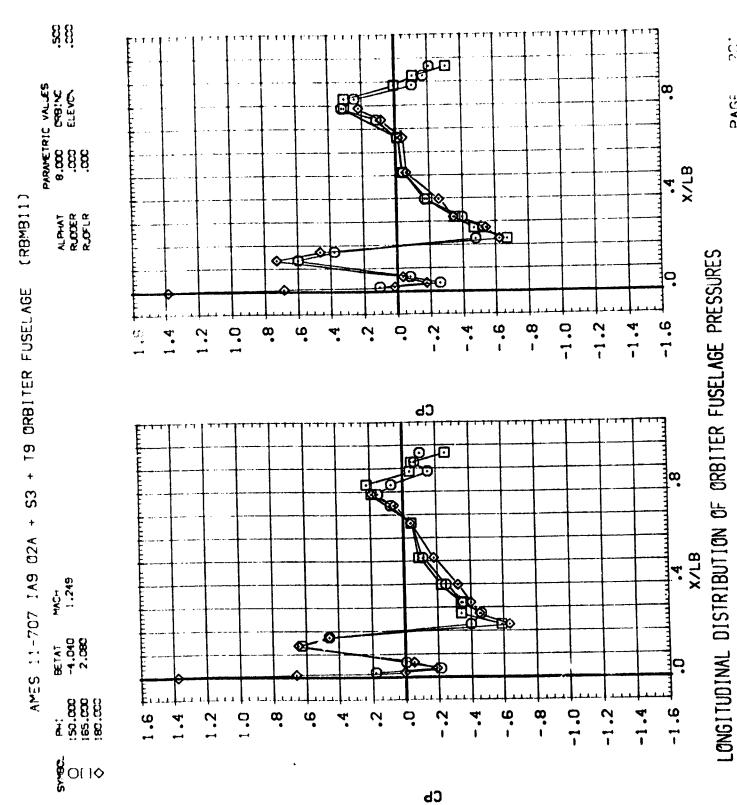


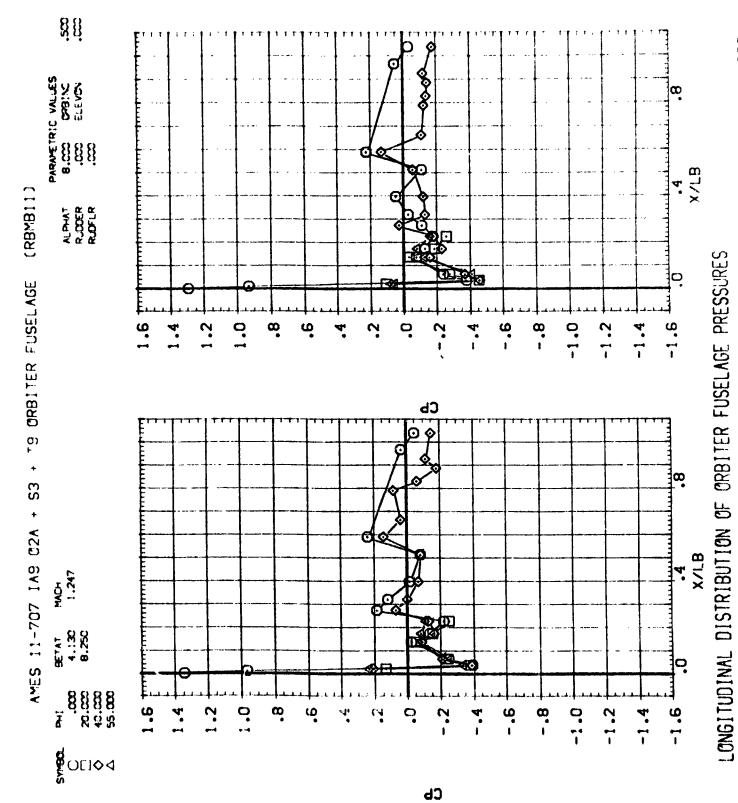


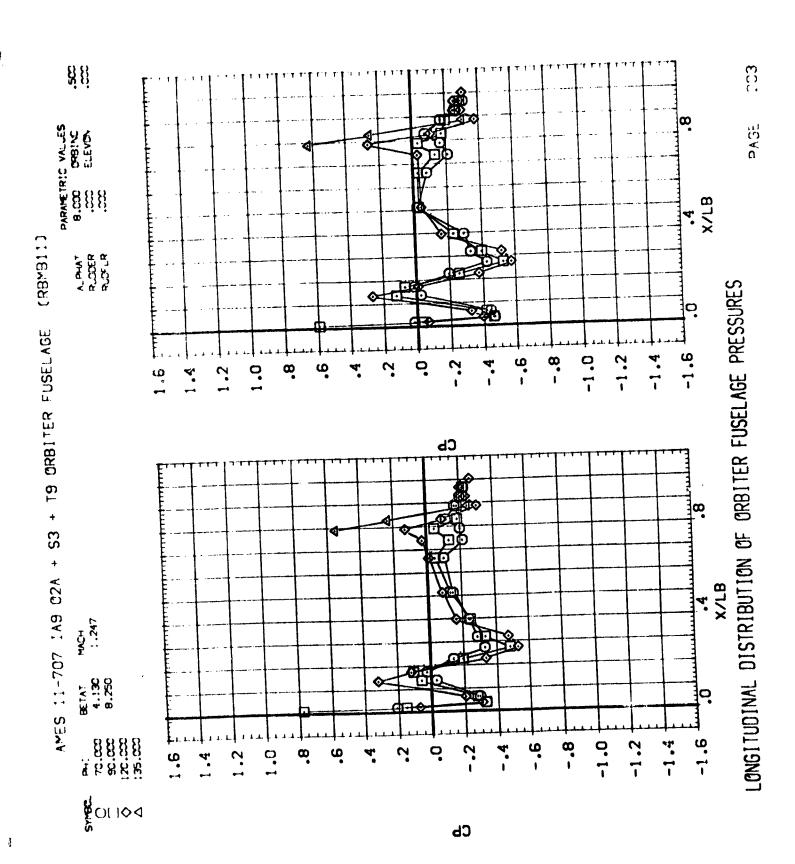


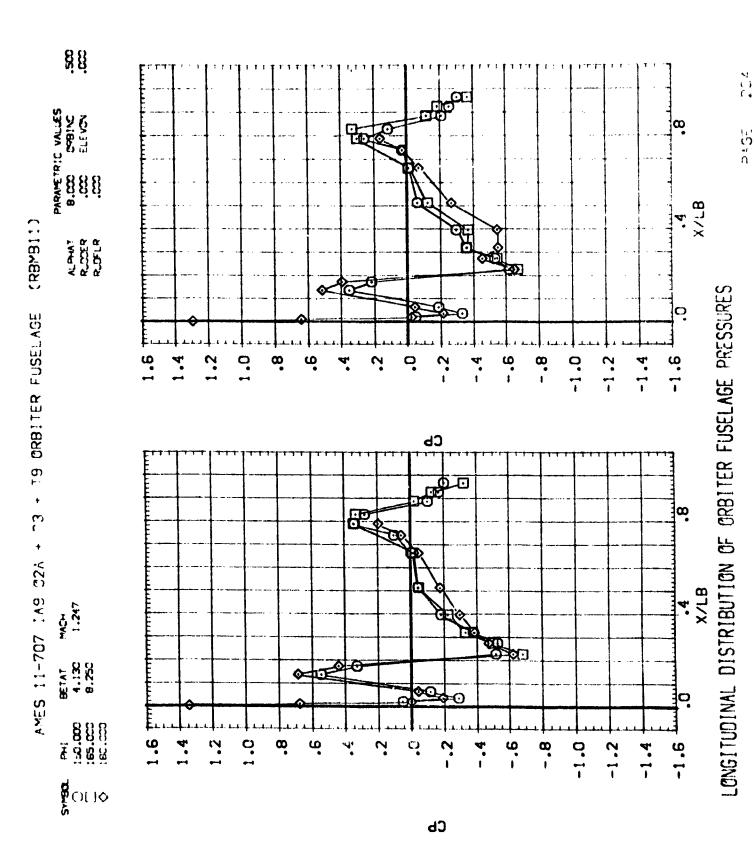


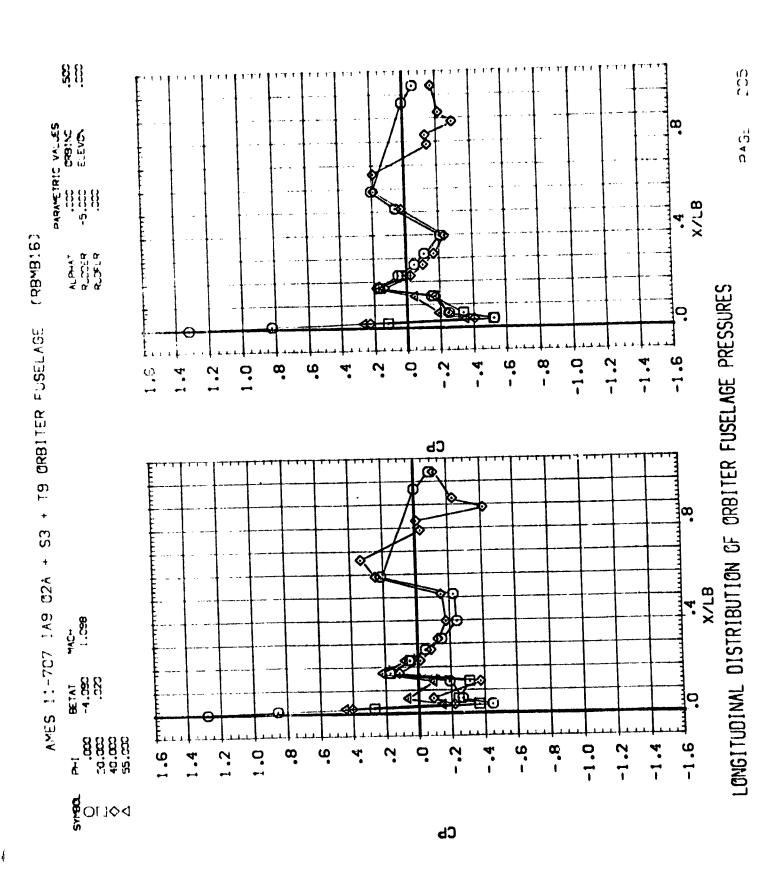


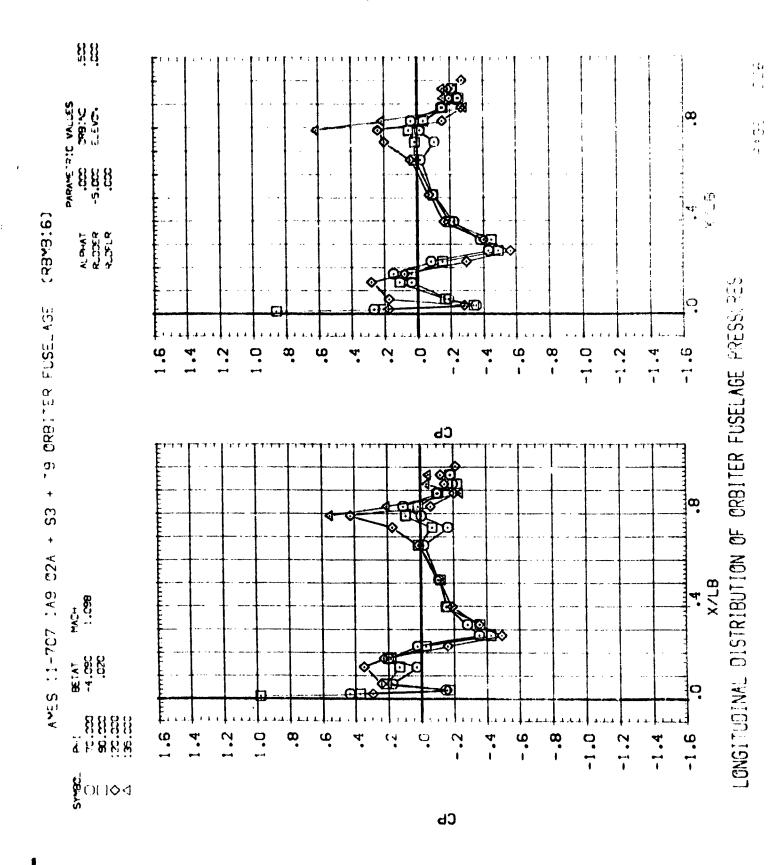


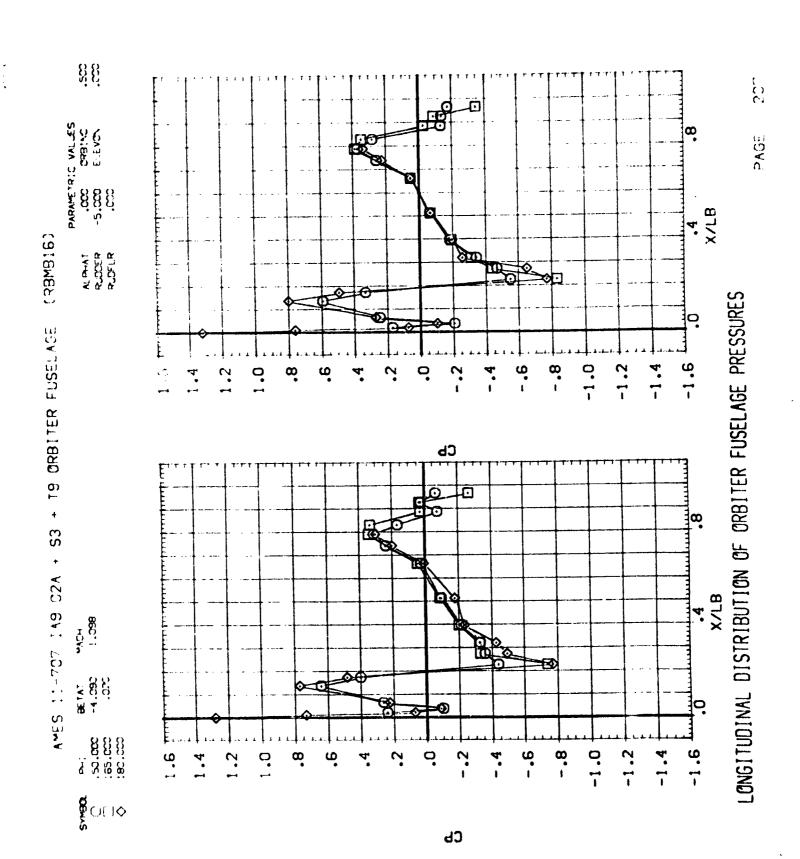


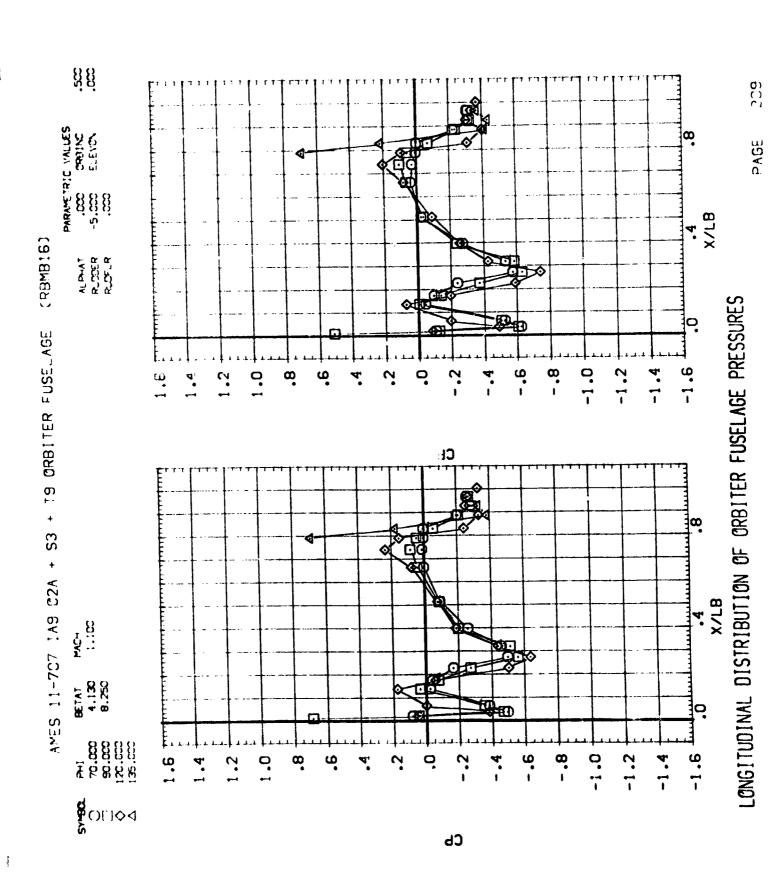


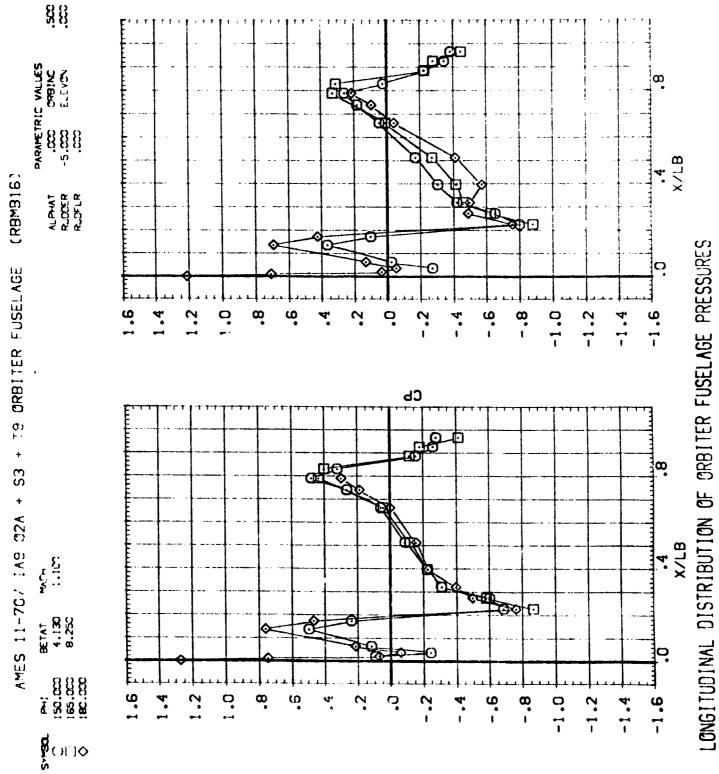




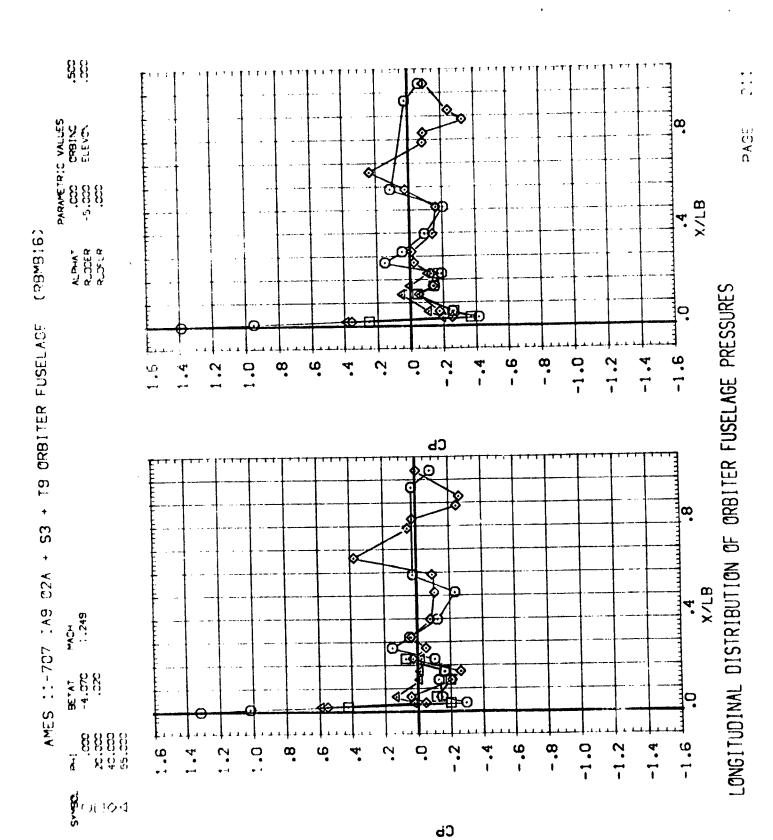


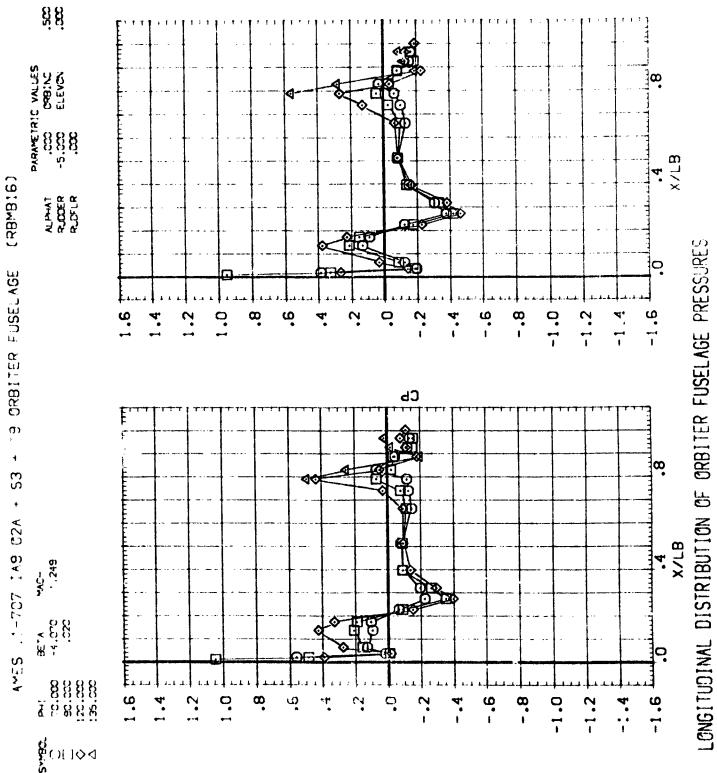






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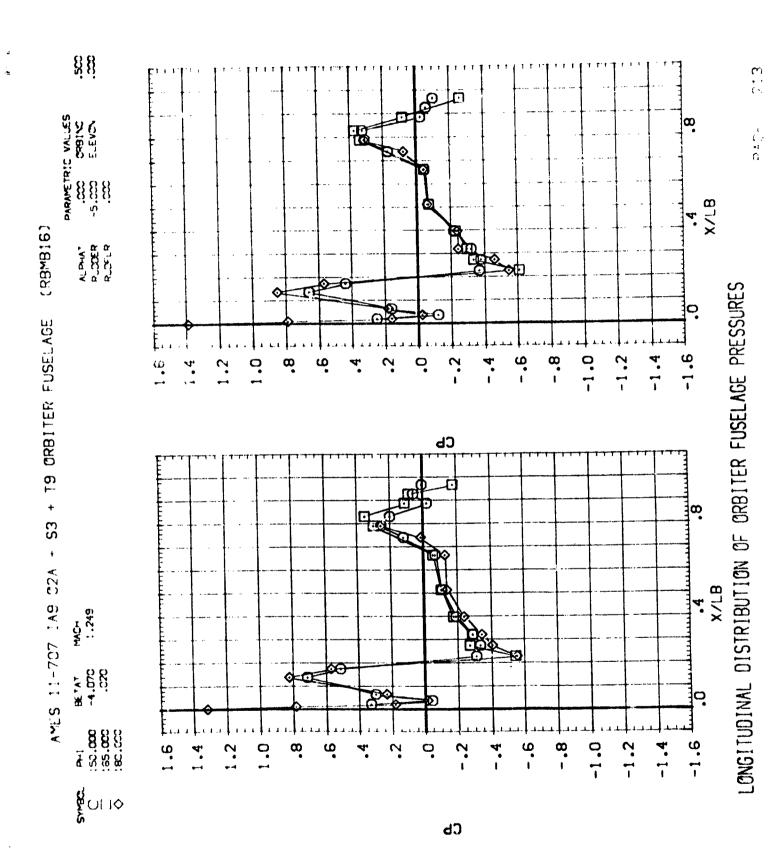


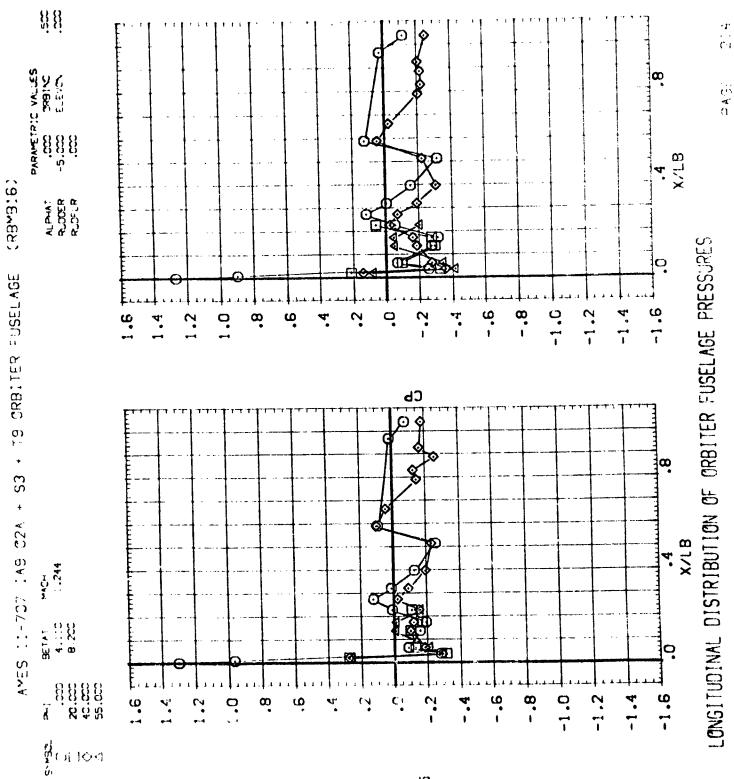


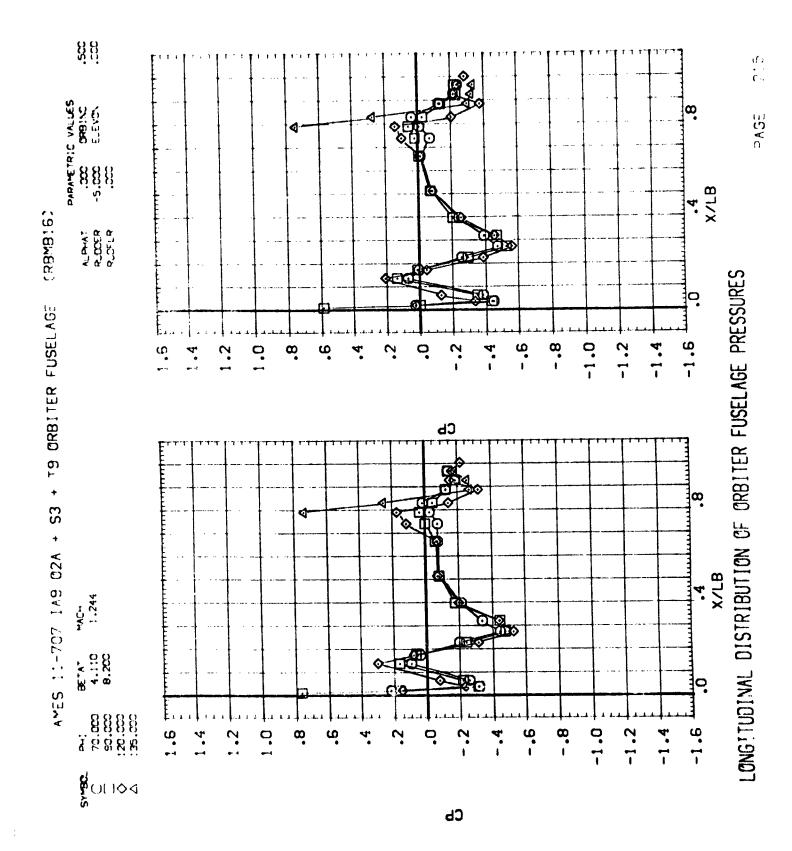
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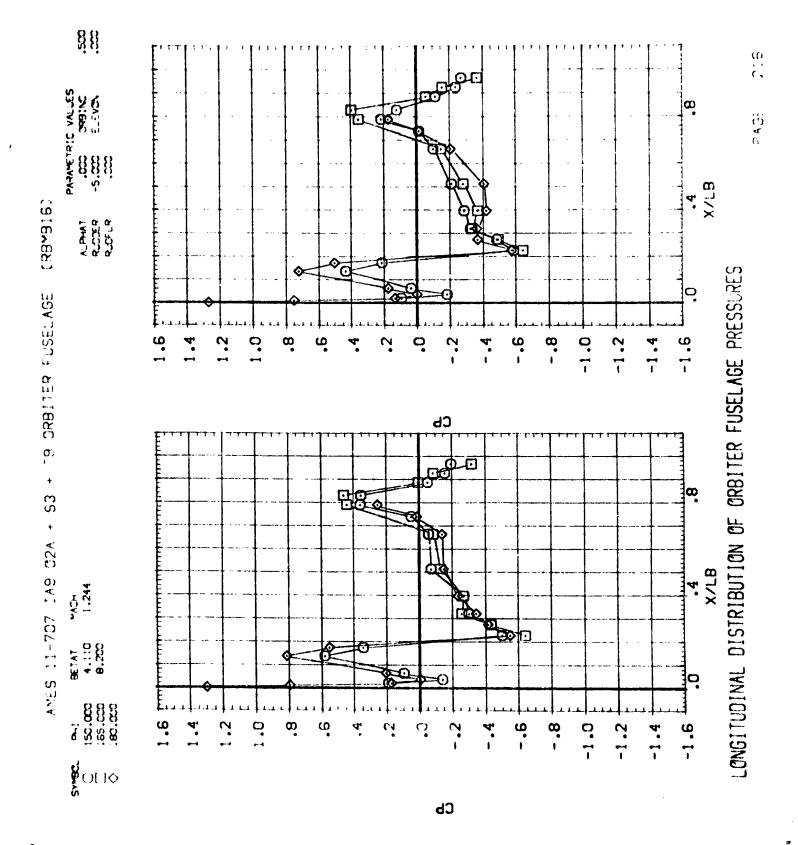
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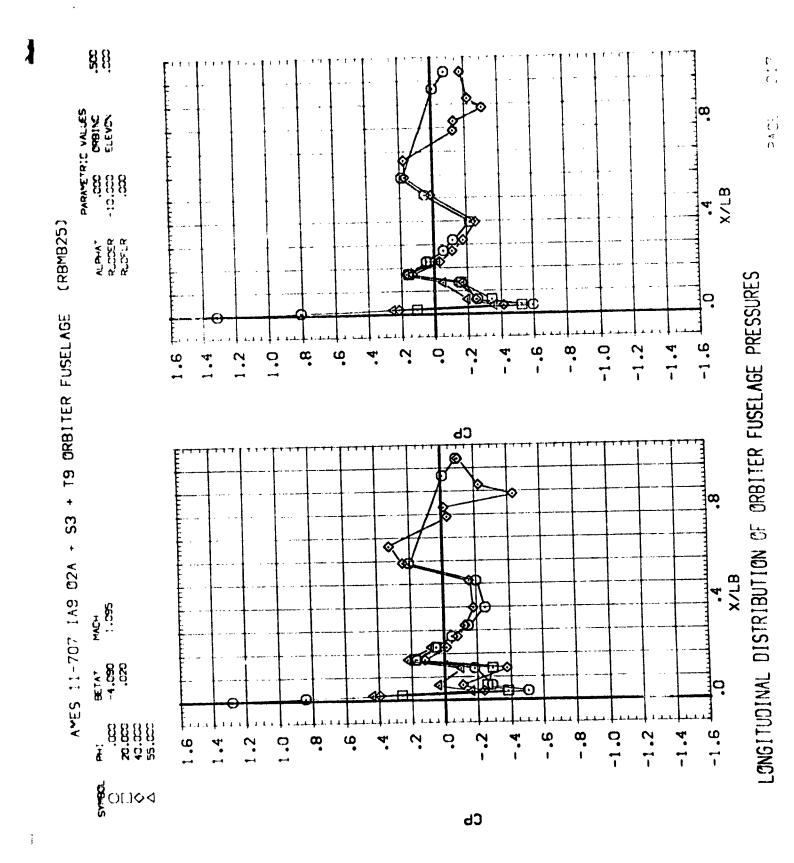
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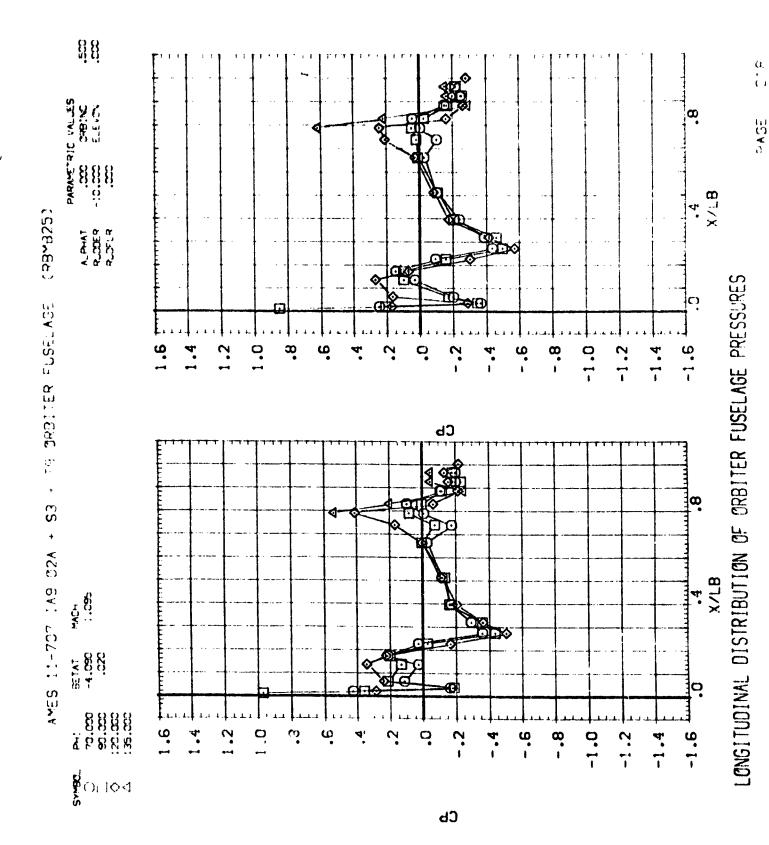


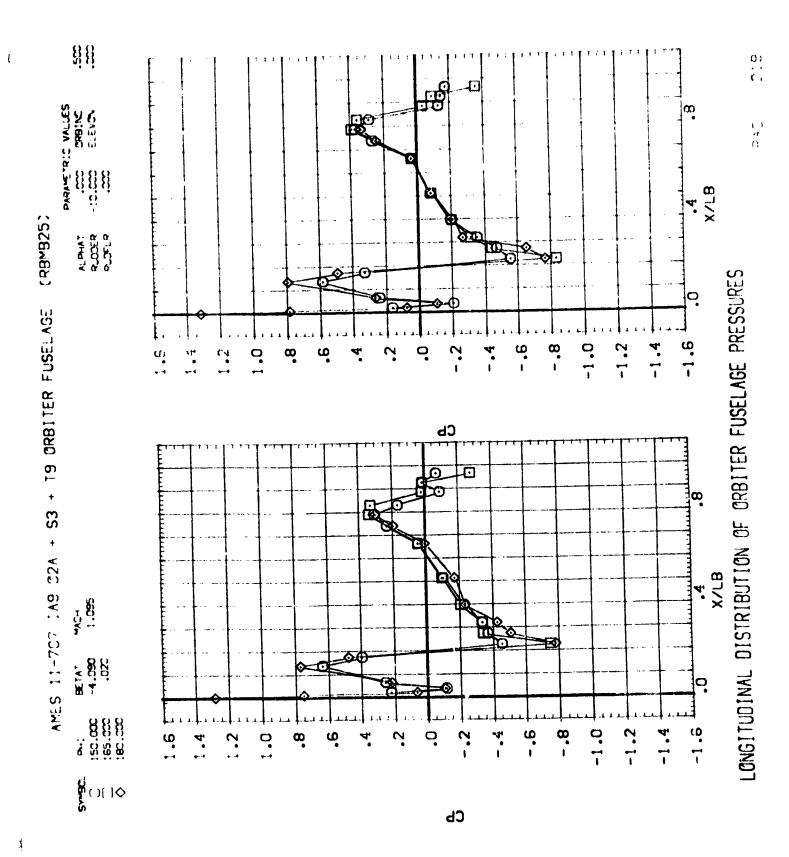


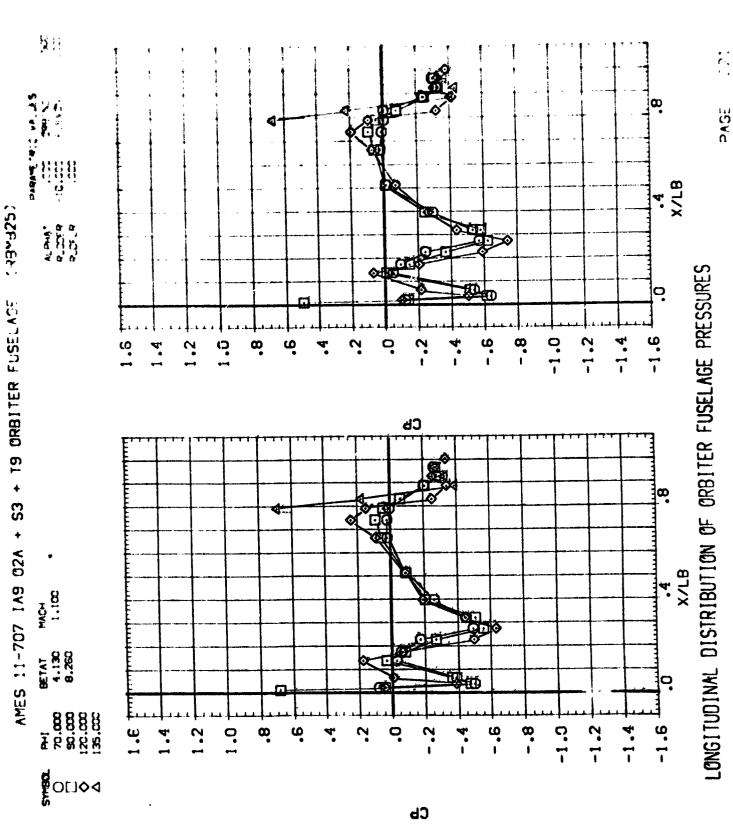








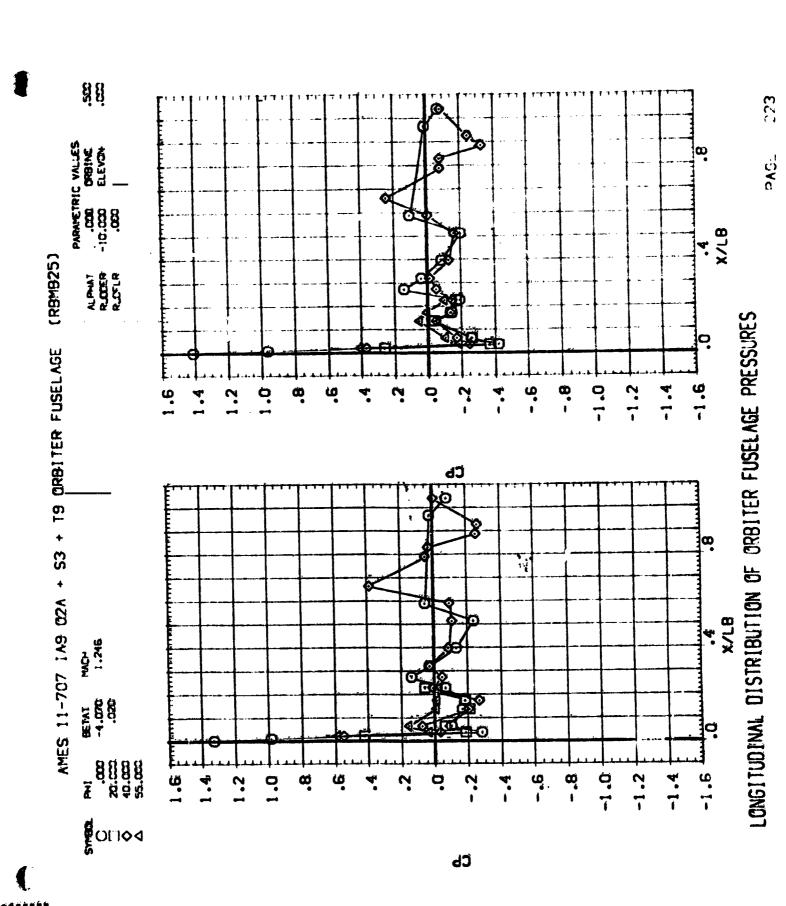


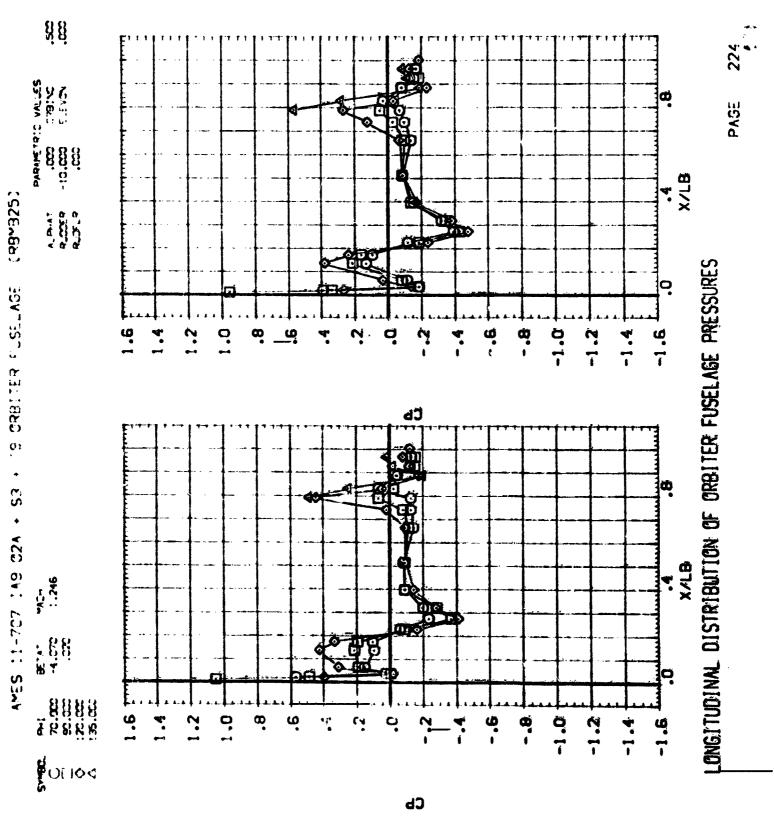


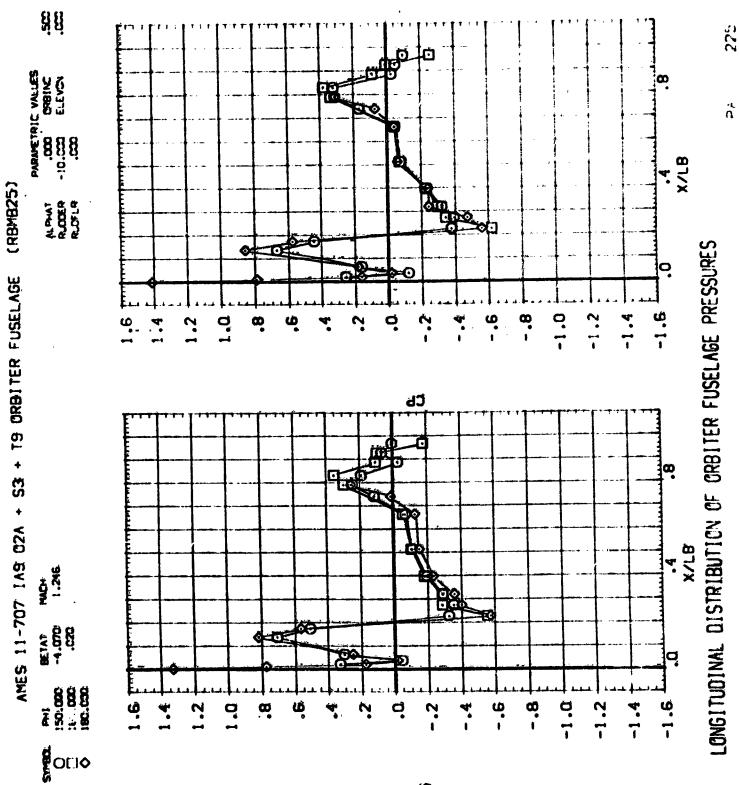
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PASE .4 X/LB LONGITUDINAL DISTRIBUTION OF ORBITER FUSELAGE PRESSURES X/LB

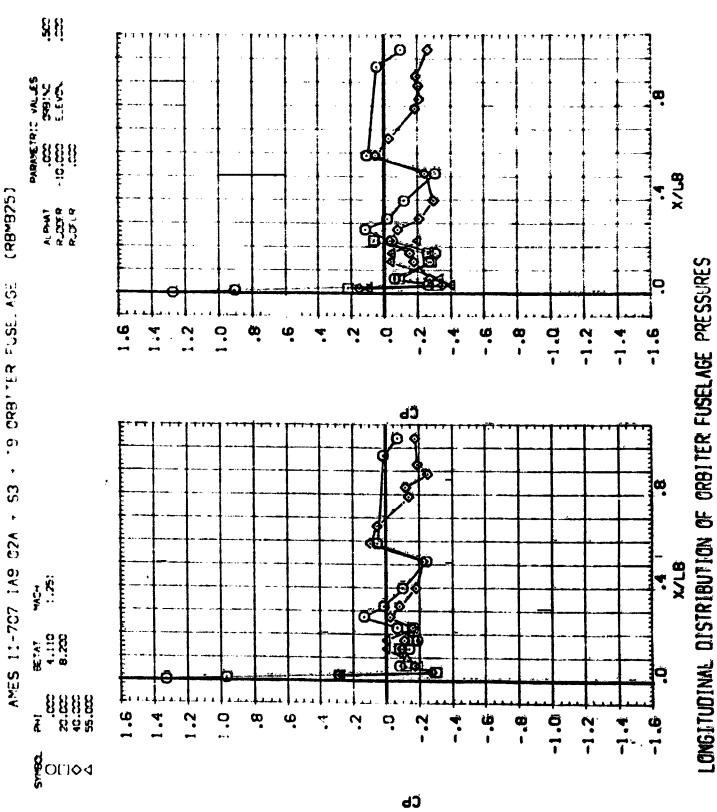
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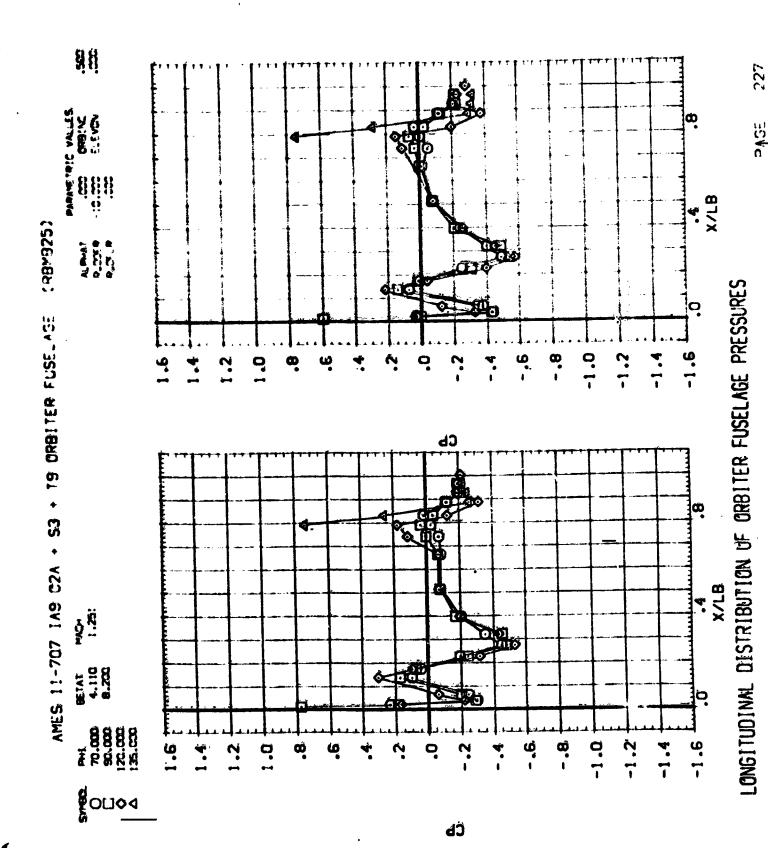


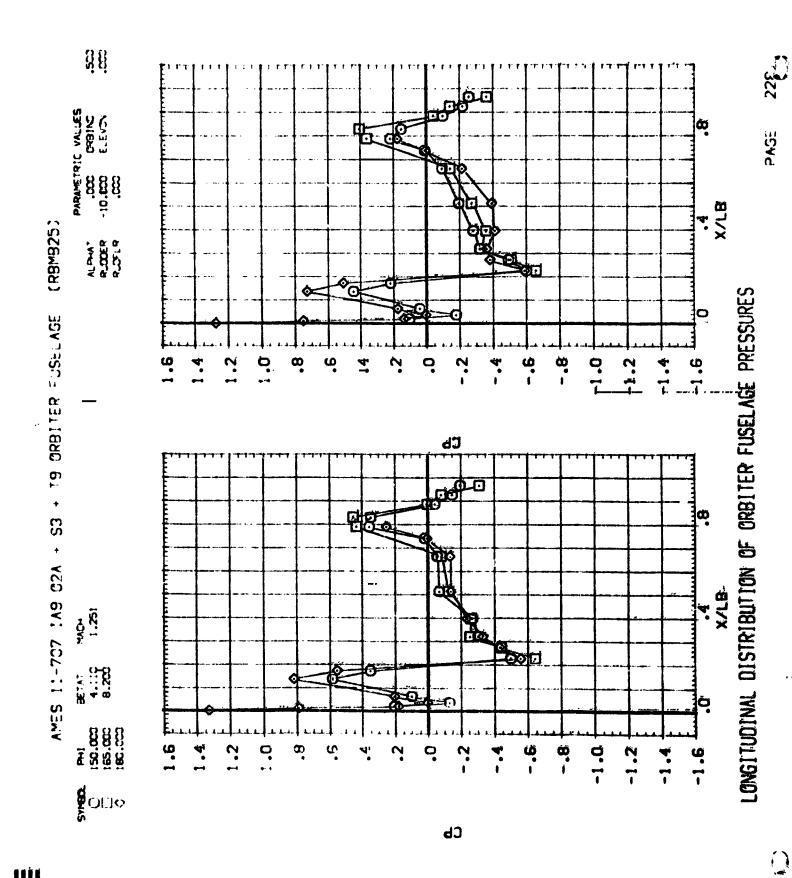
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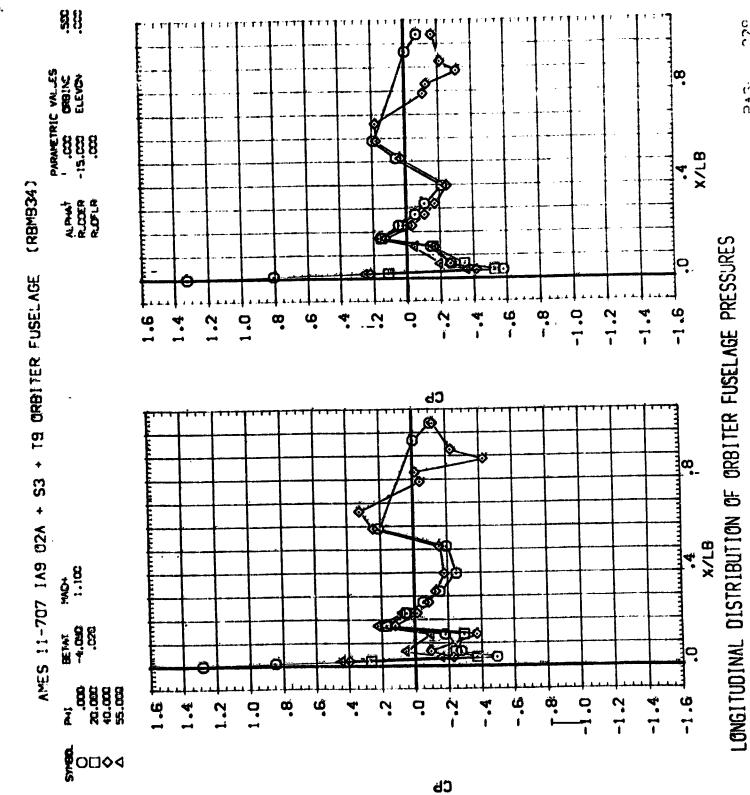


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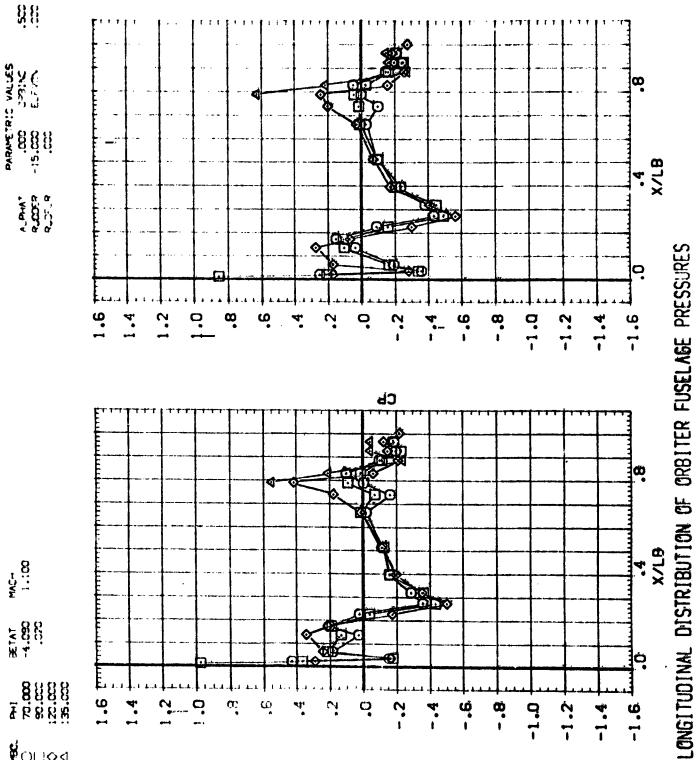
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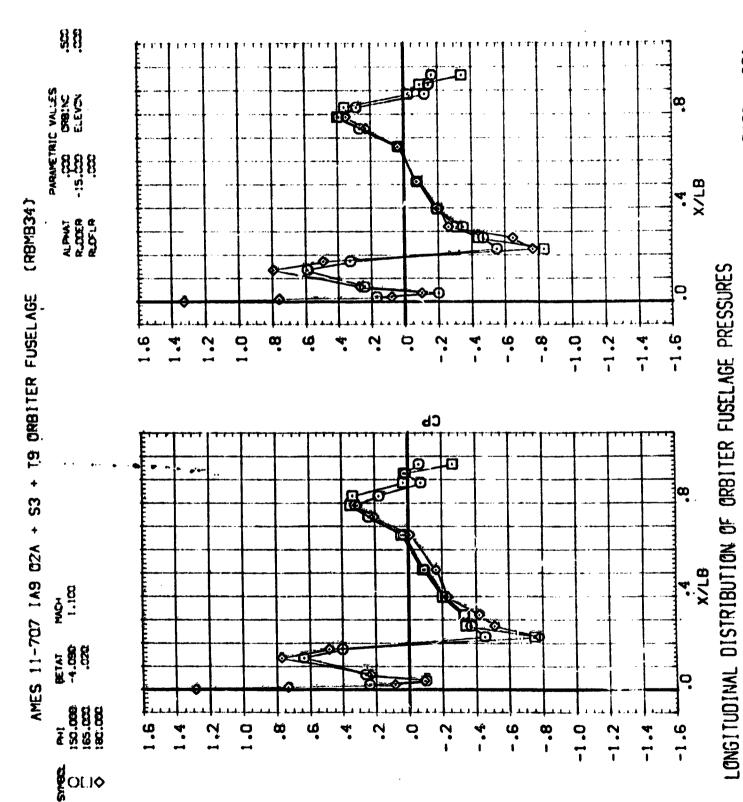
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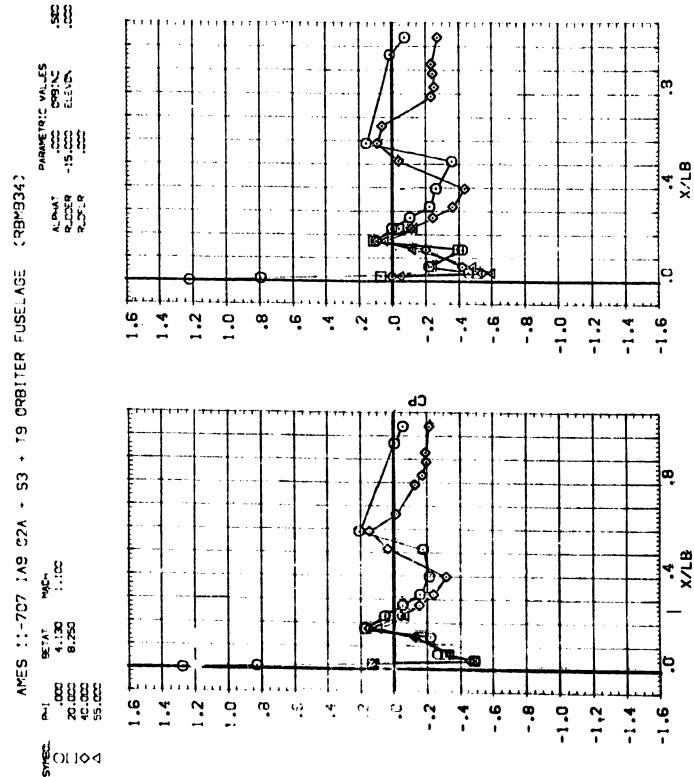




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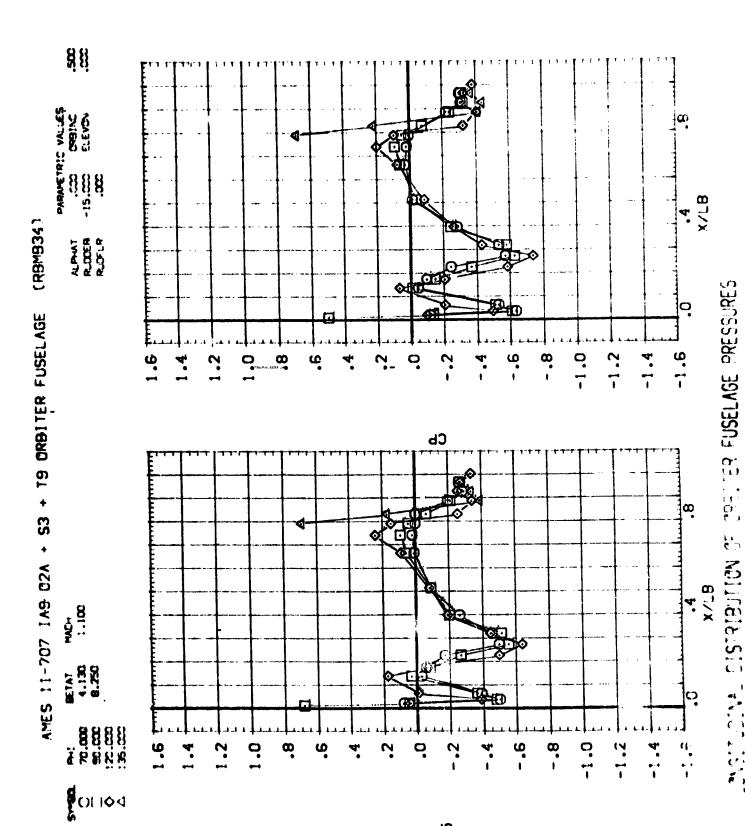
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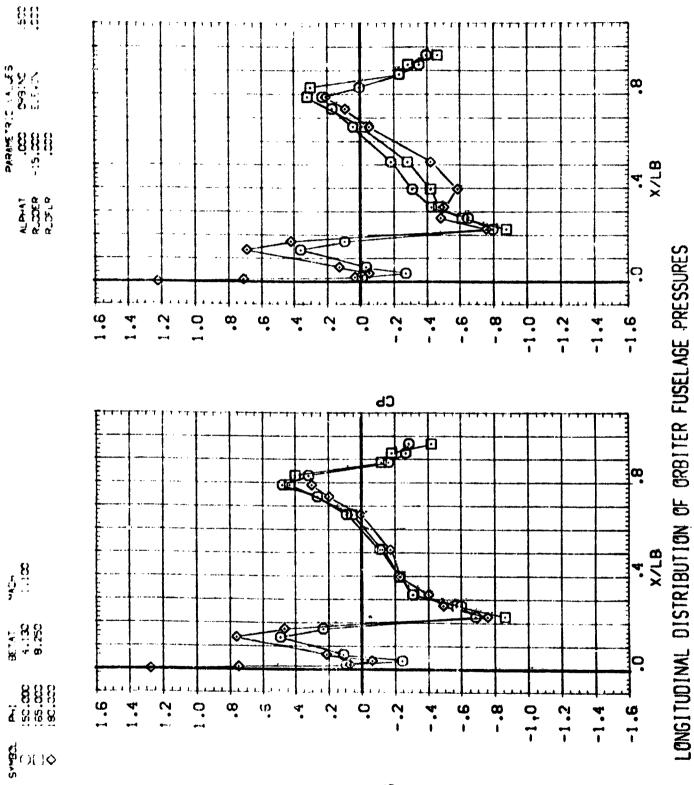


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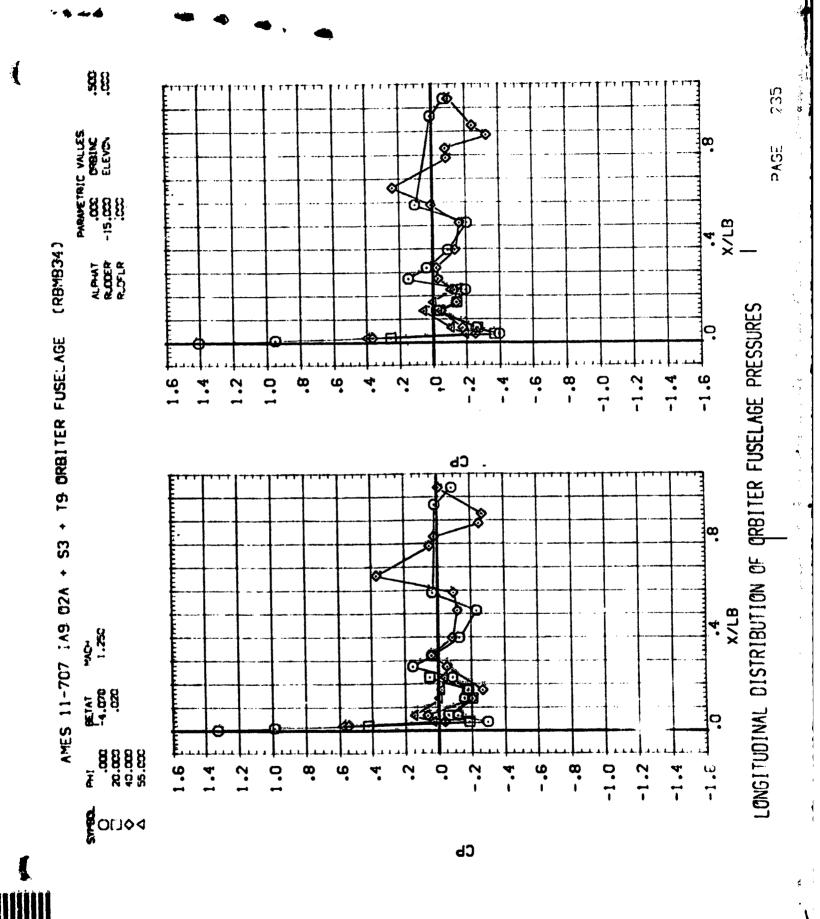


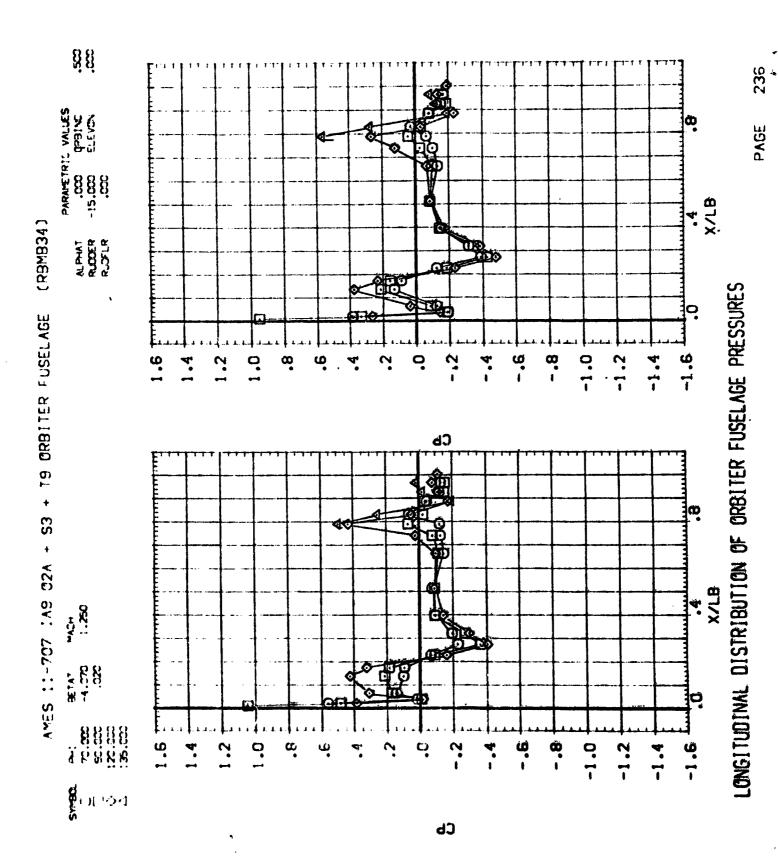
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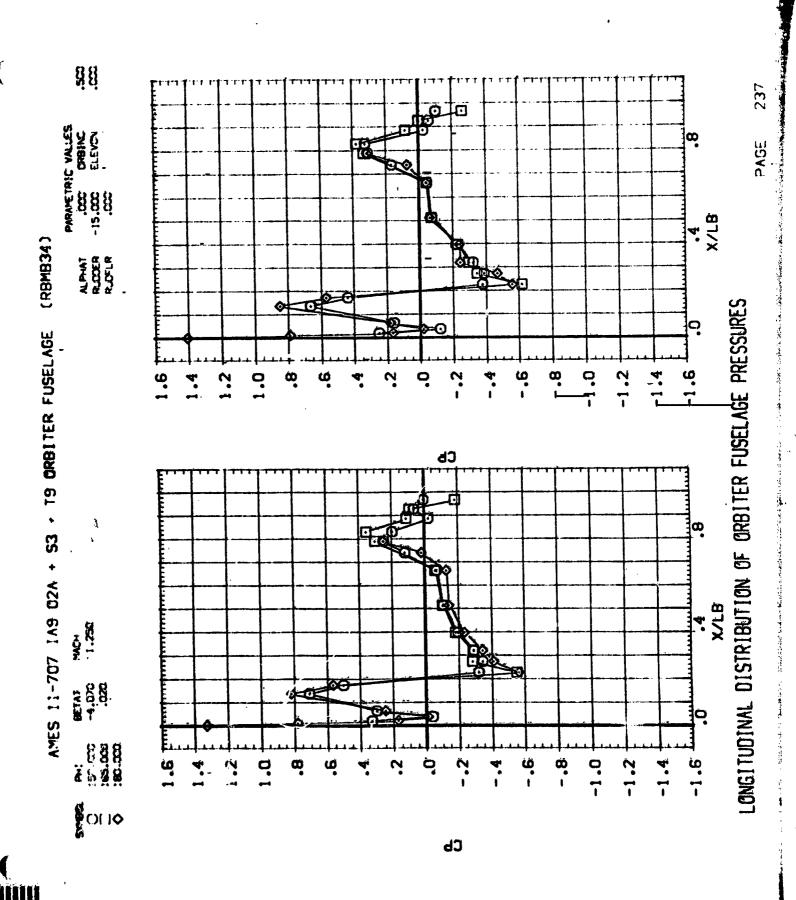


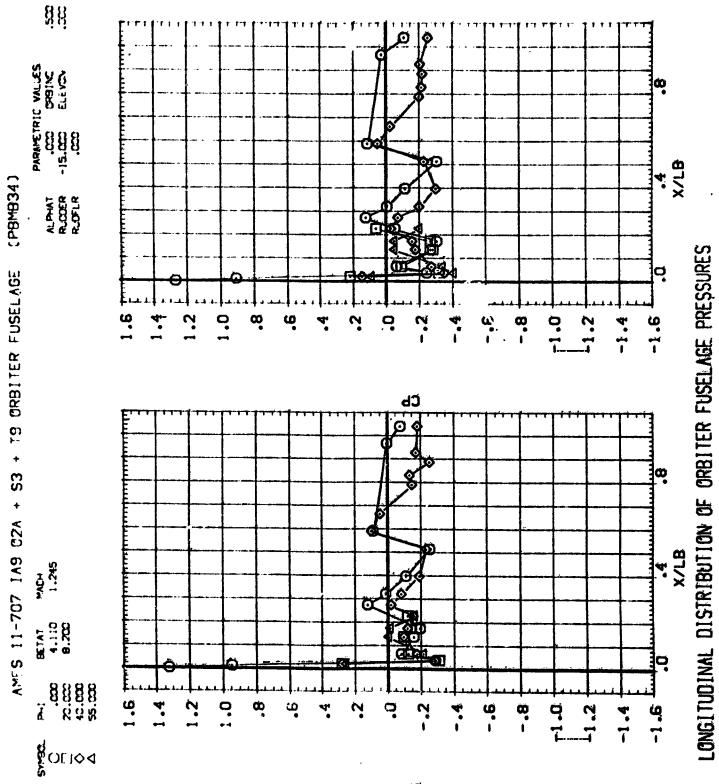
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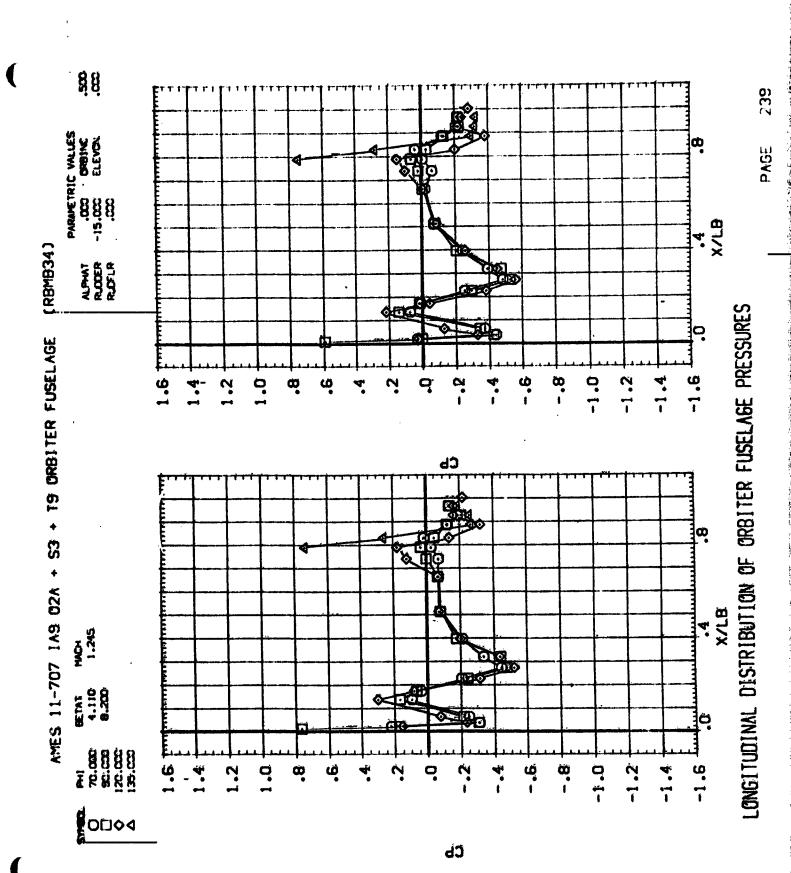




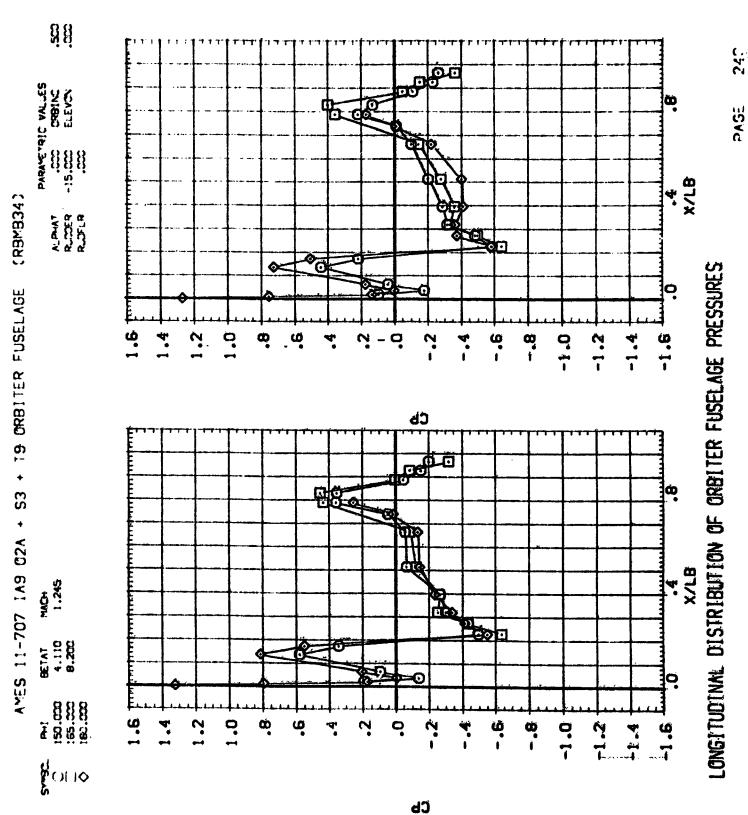


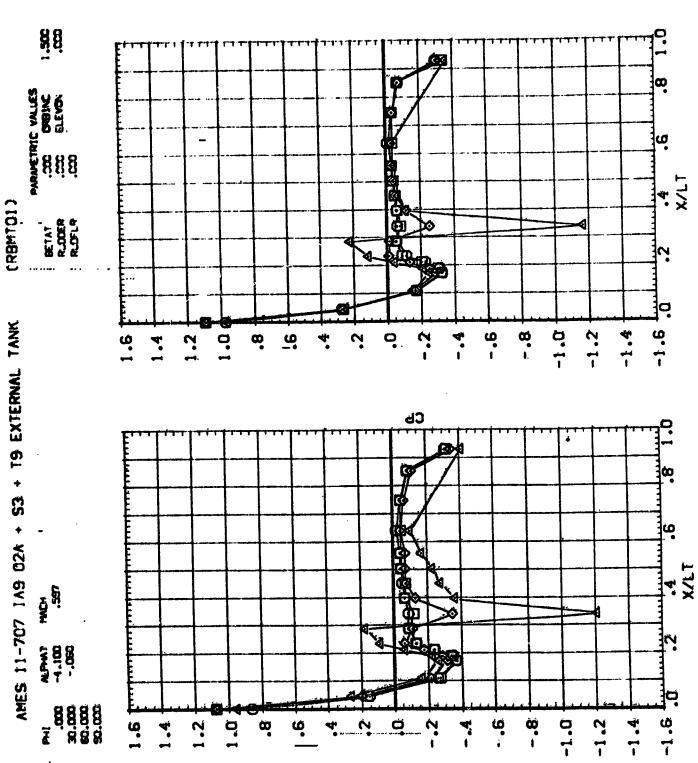
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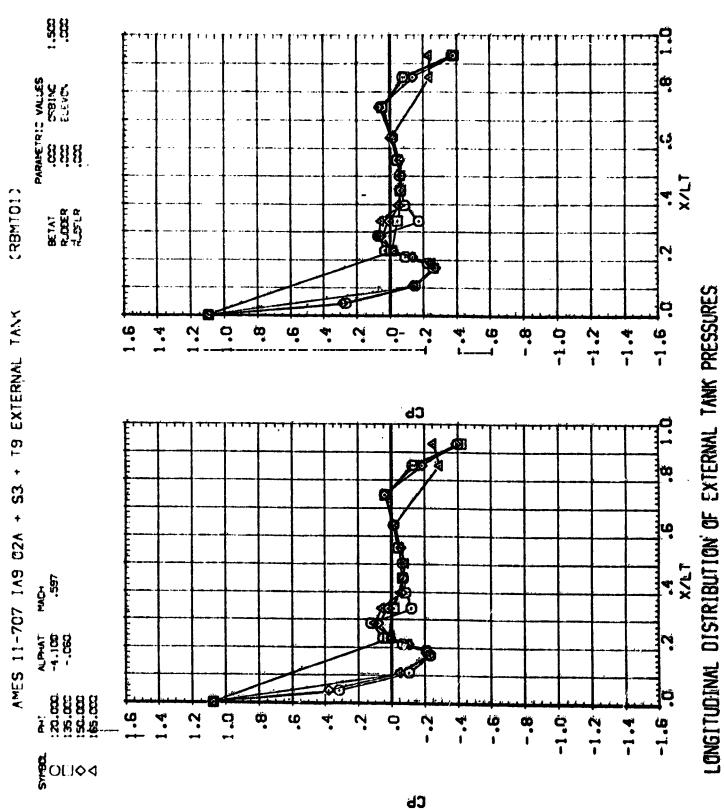
LONGITUDINAL DISTRIBUTION OF EXTERNAL TANK PRESSURES

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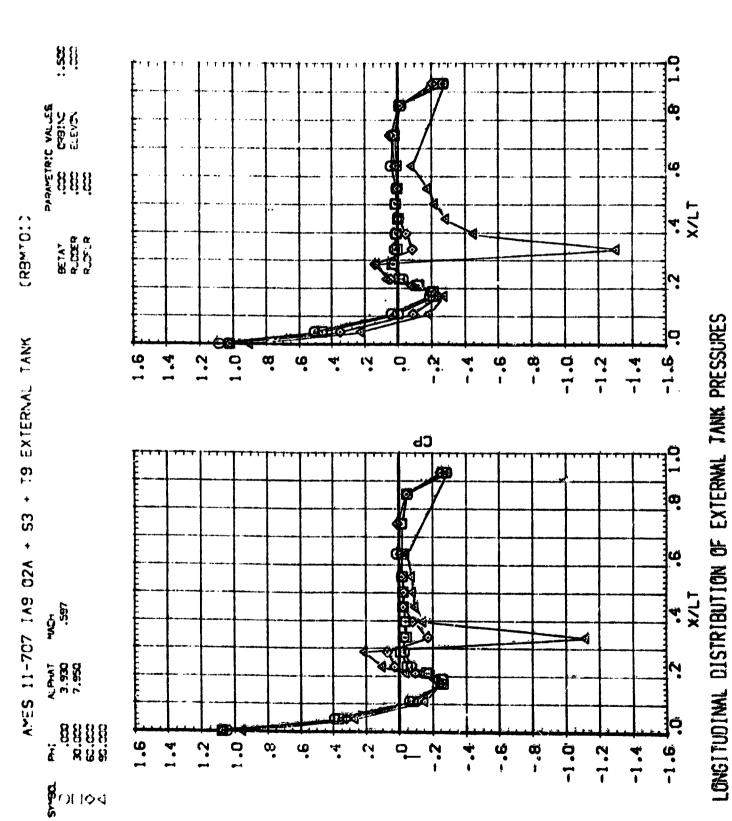
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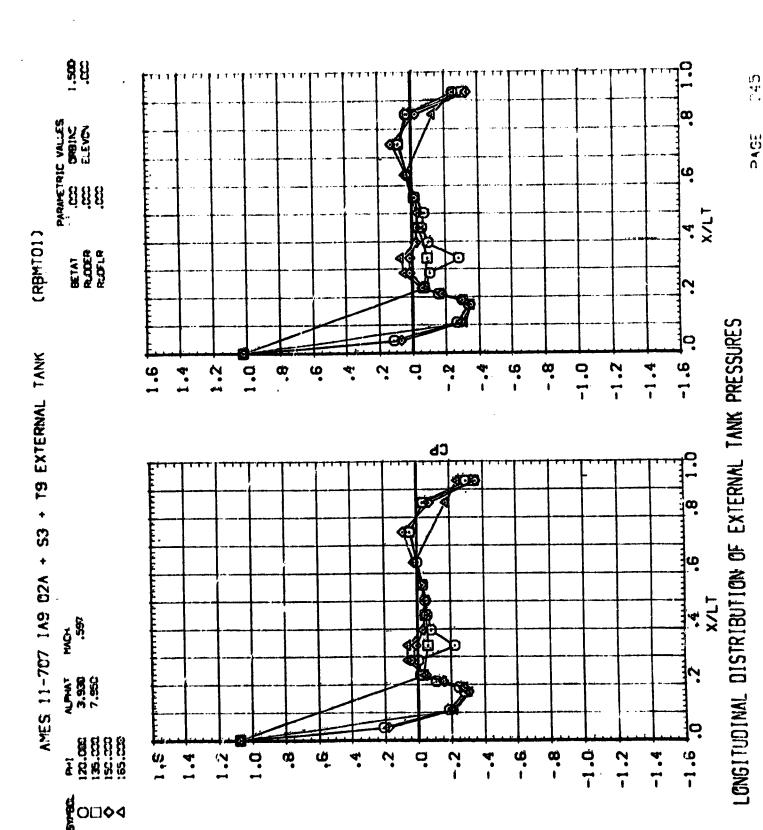


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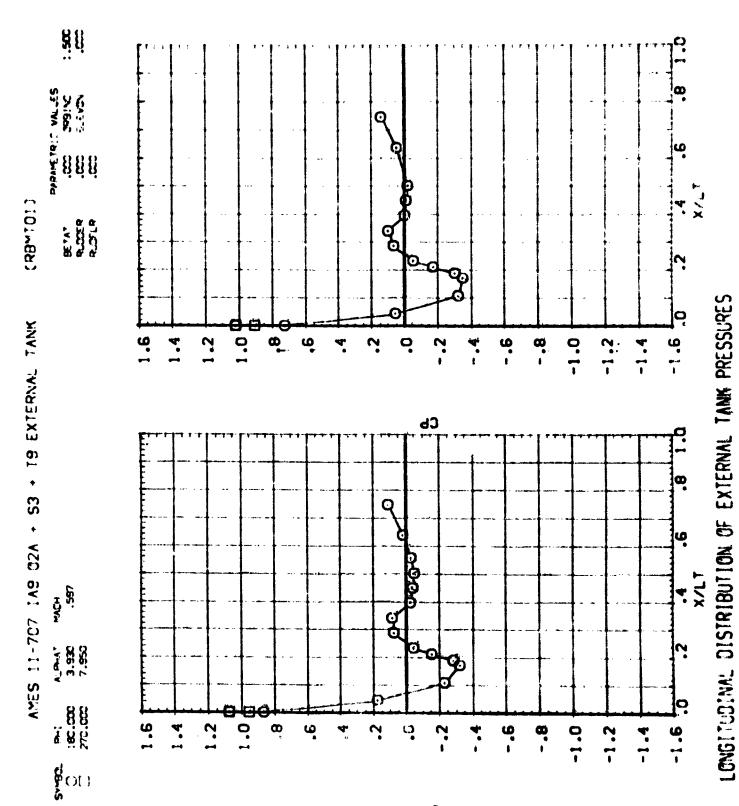
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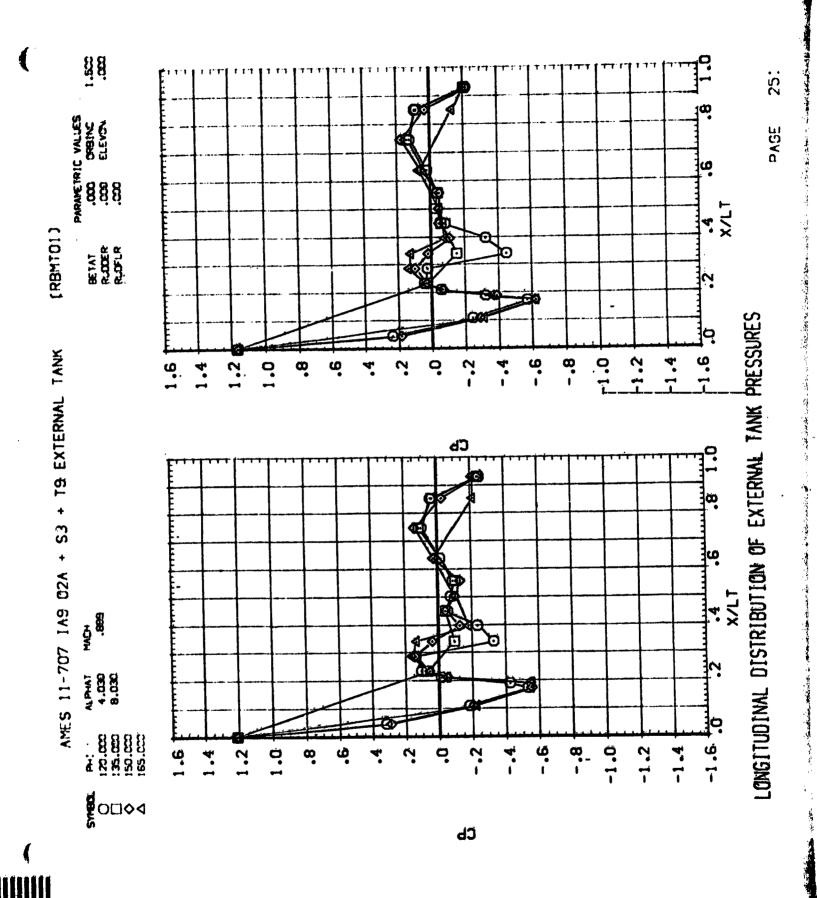
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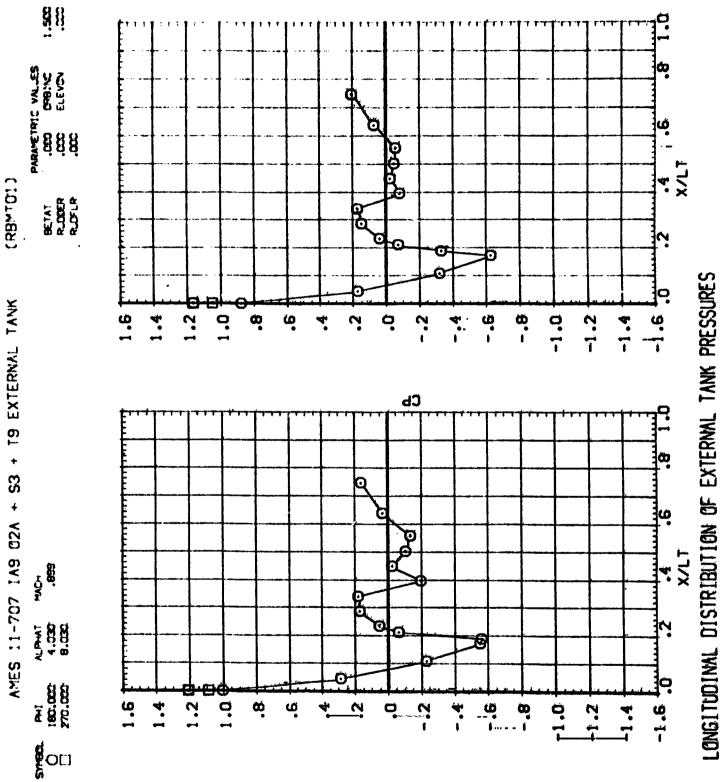
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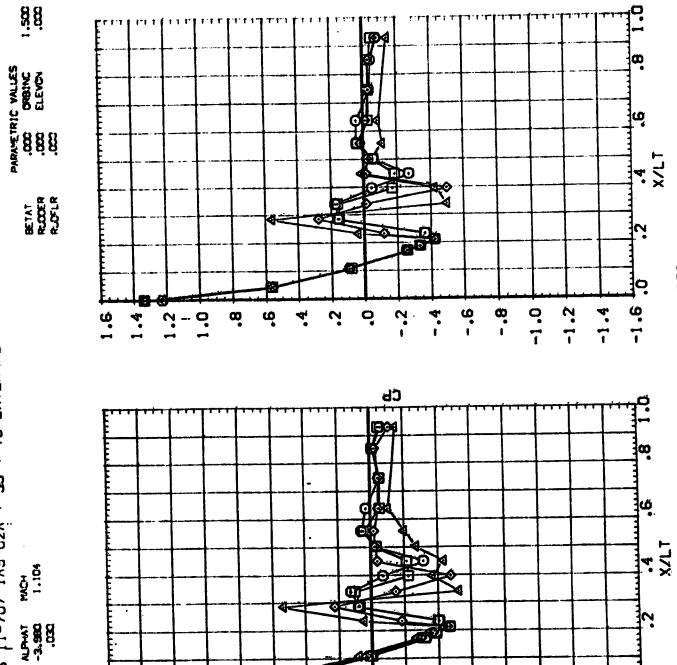
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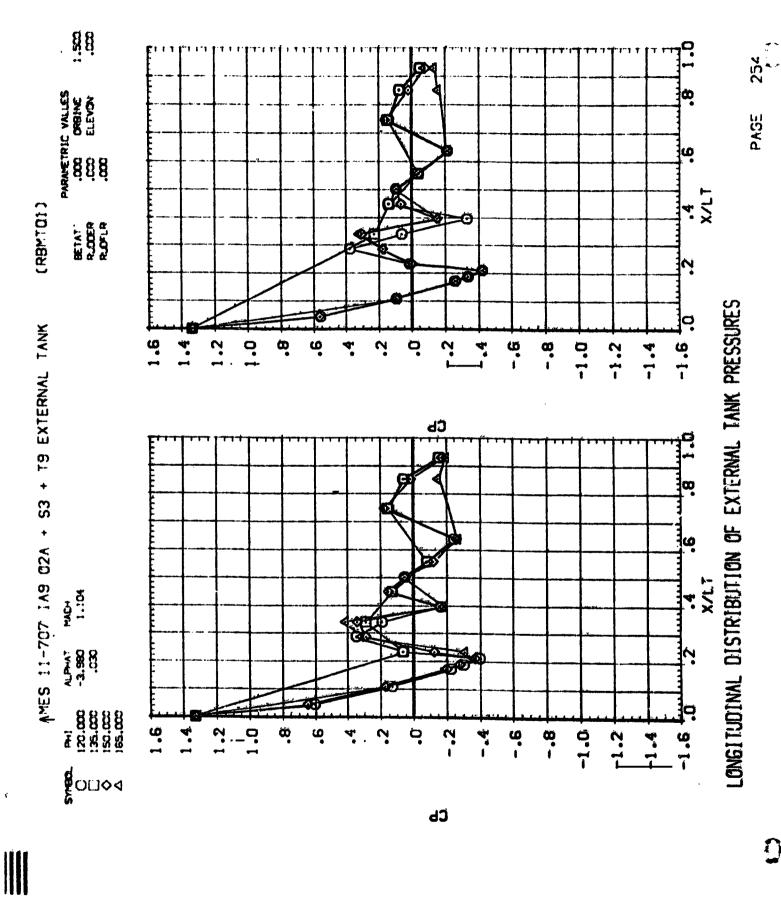
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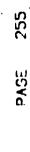
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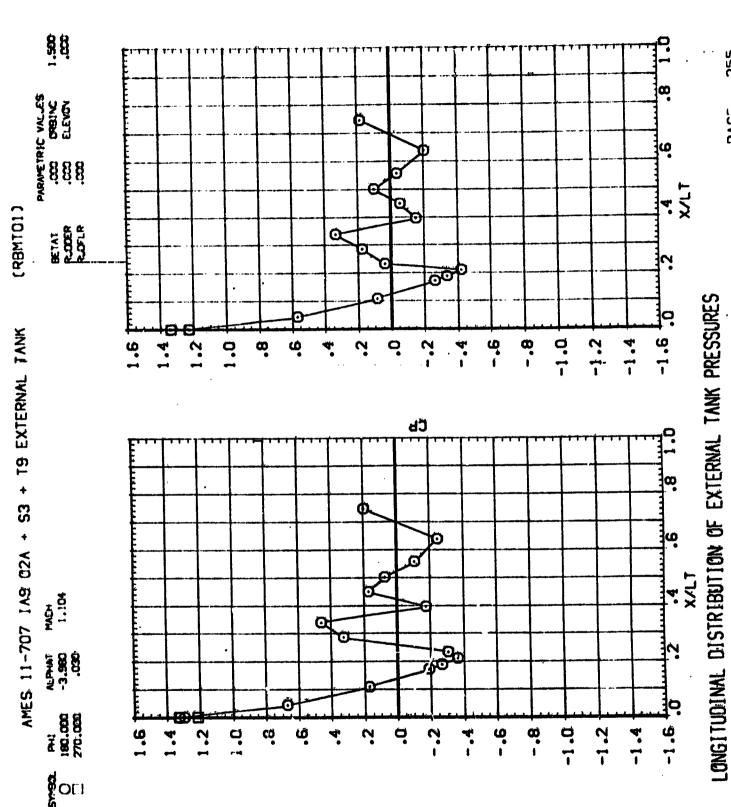
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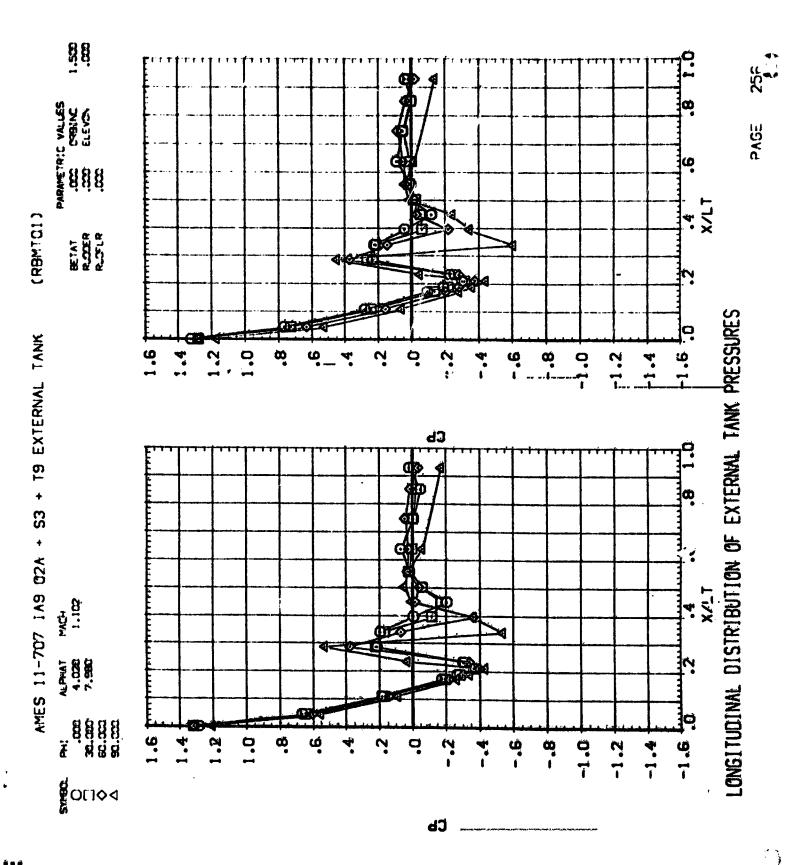
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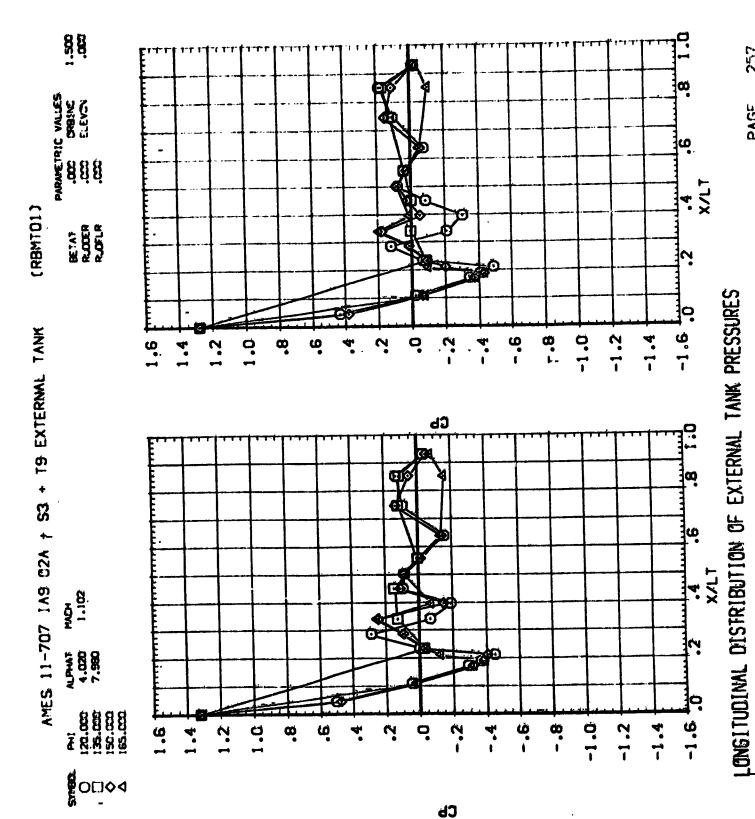




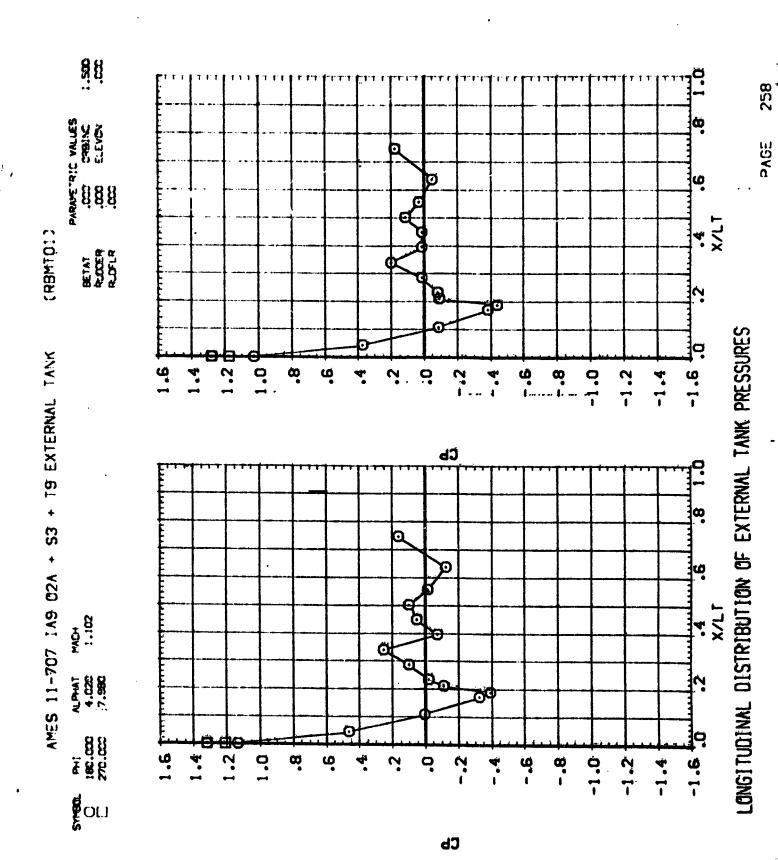


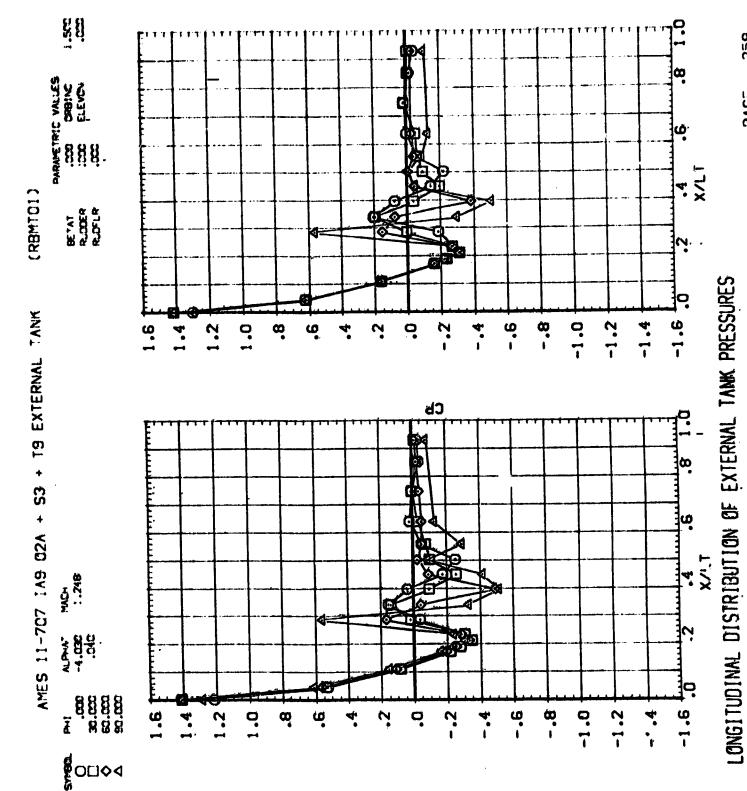
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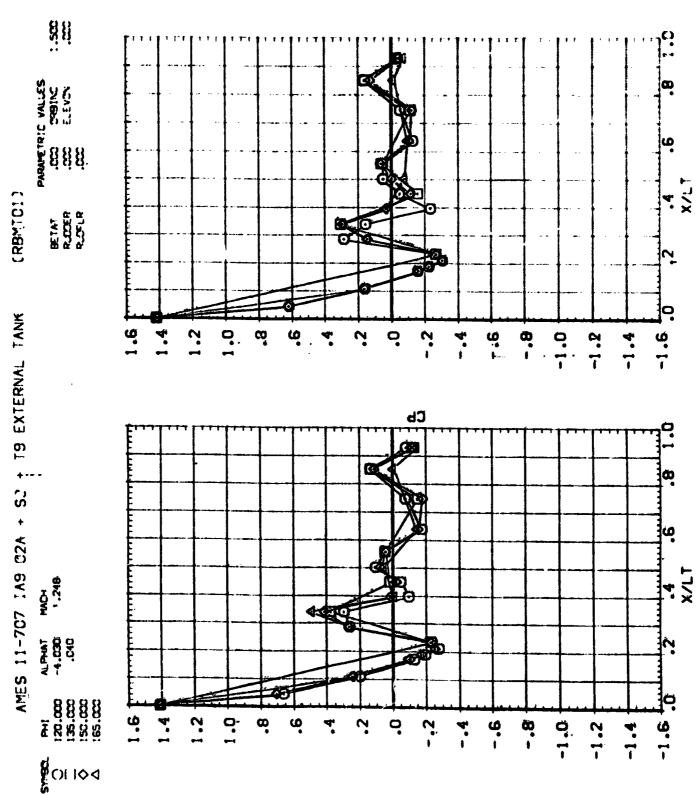


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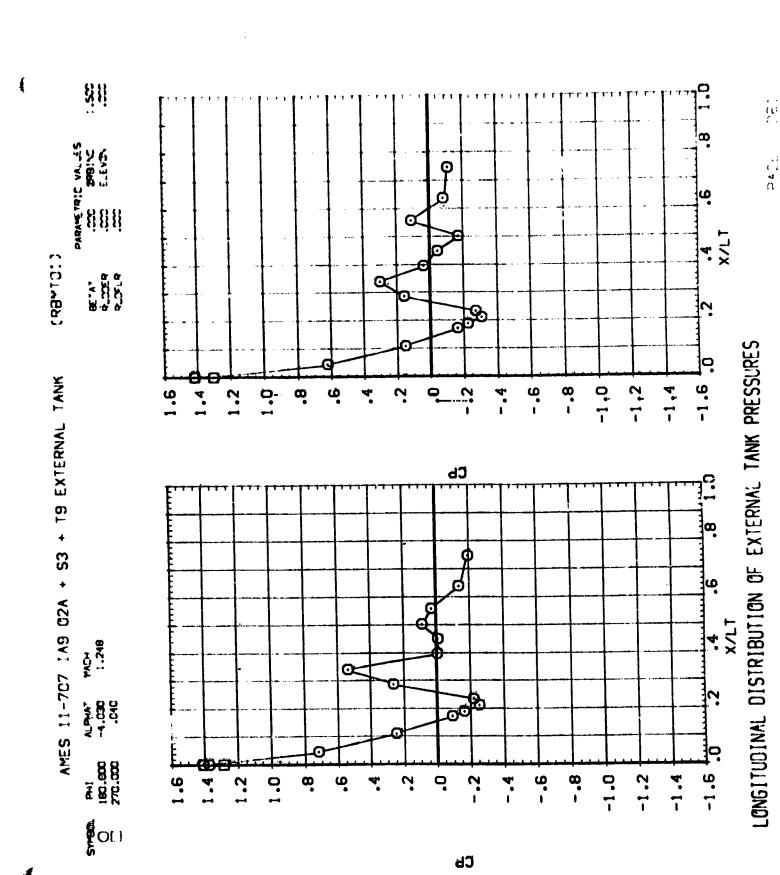


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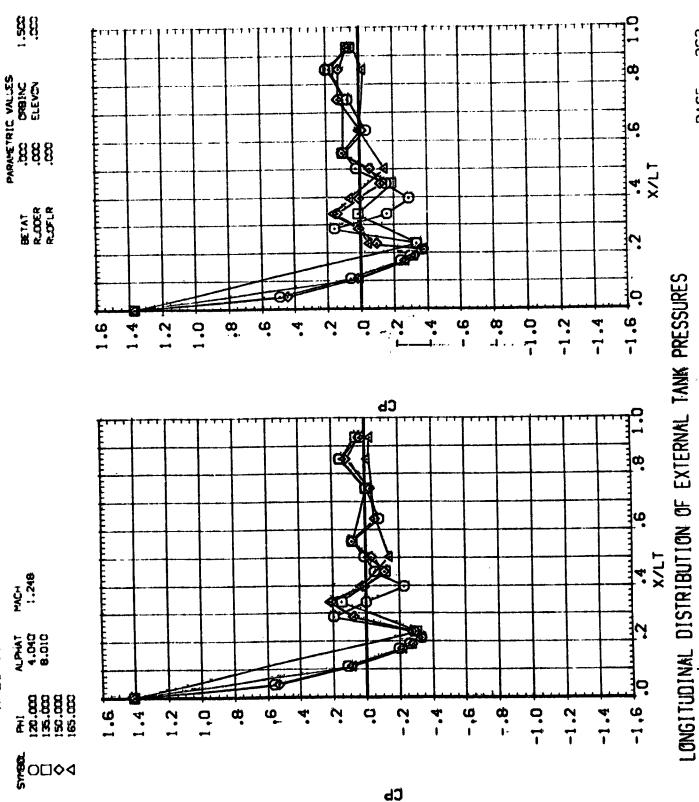
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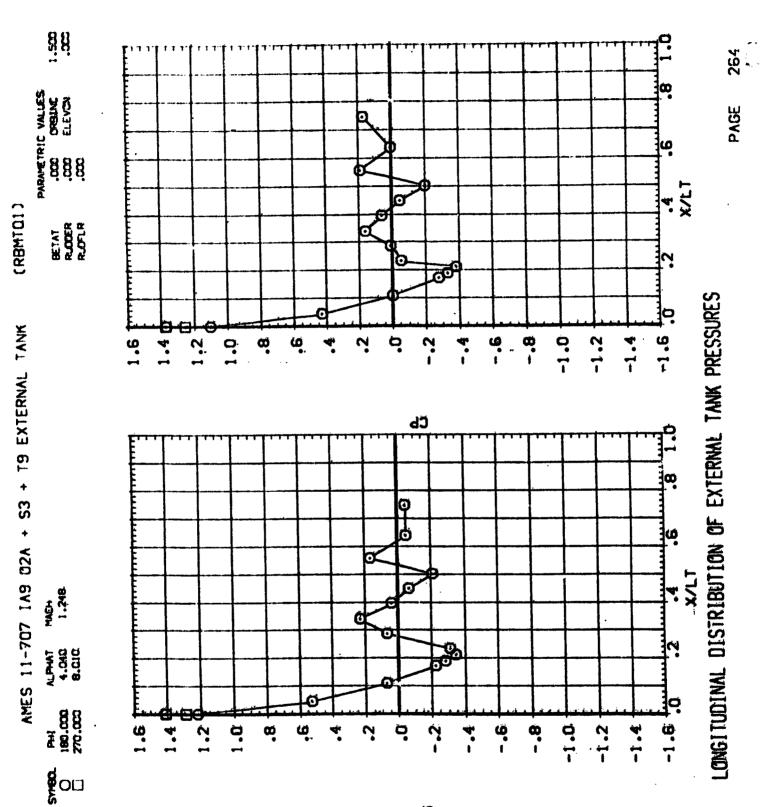


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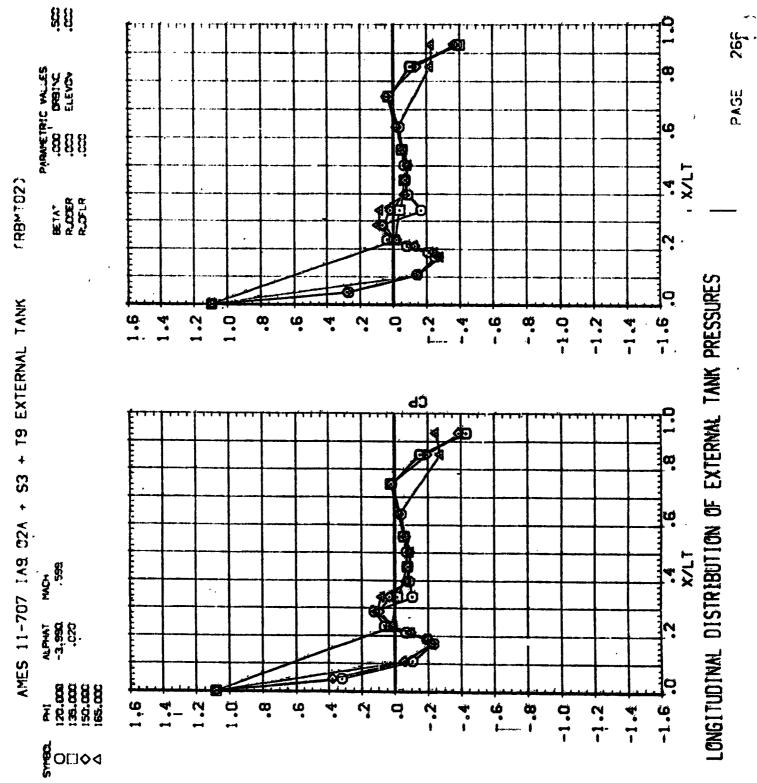
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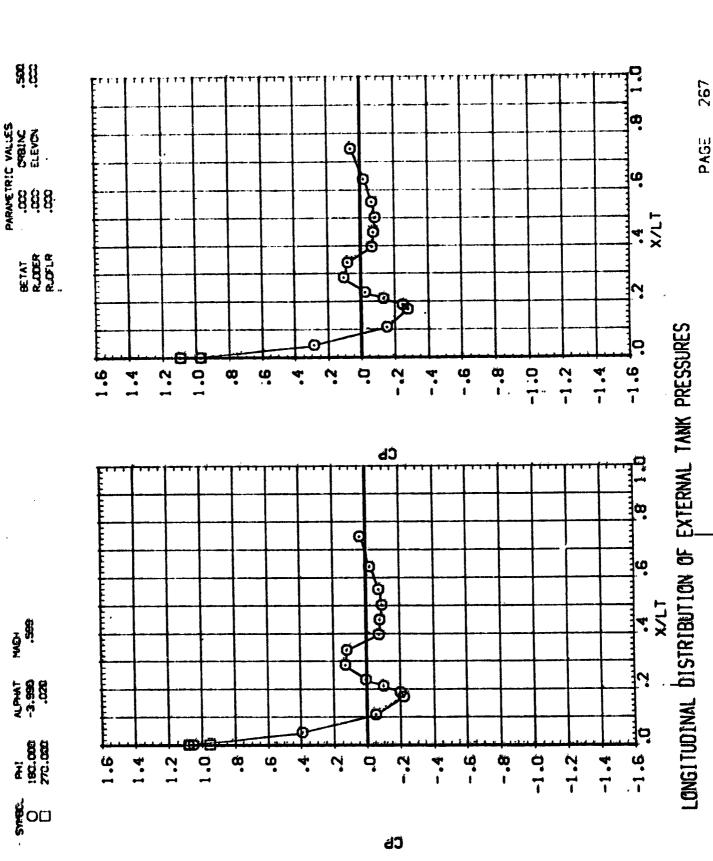
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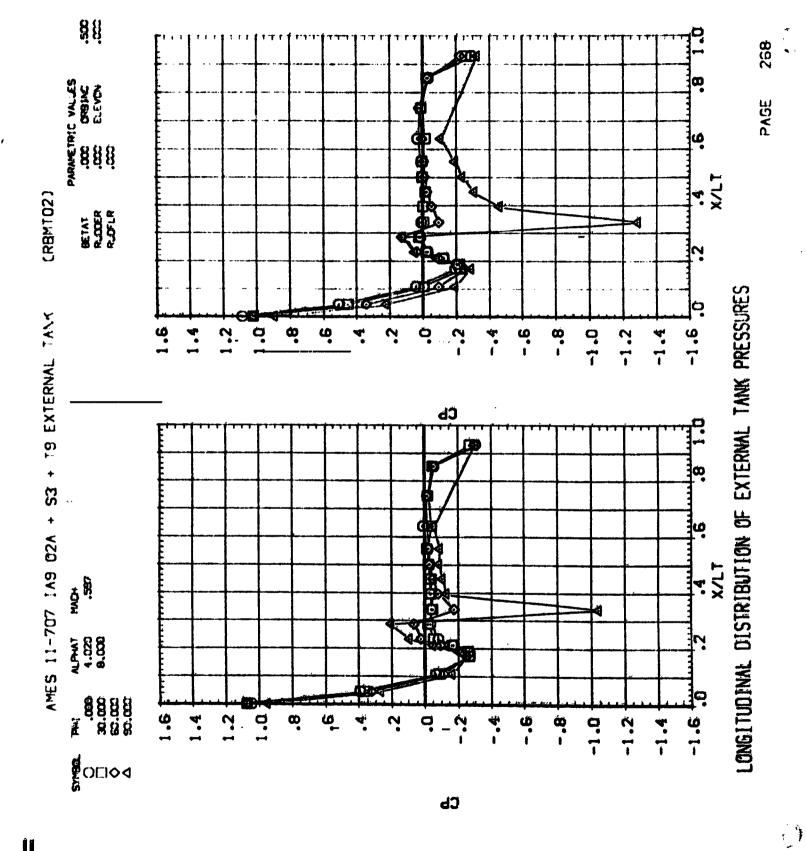
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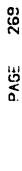
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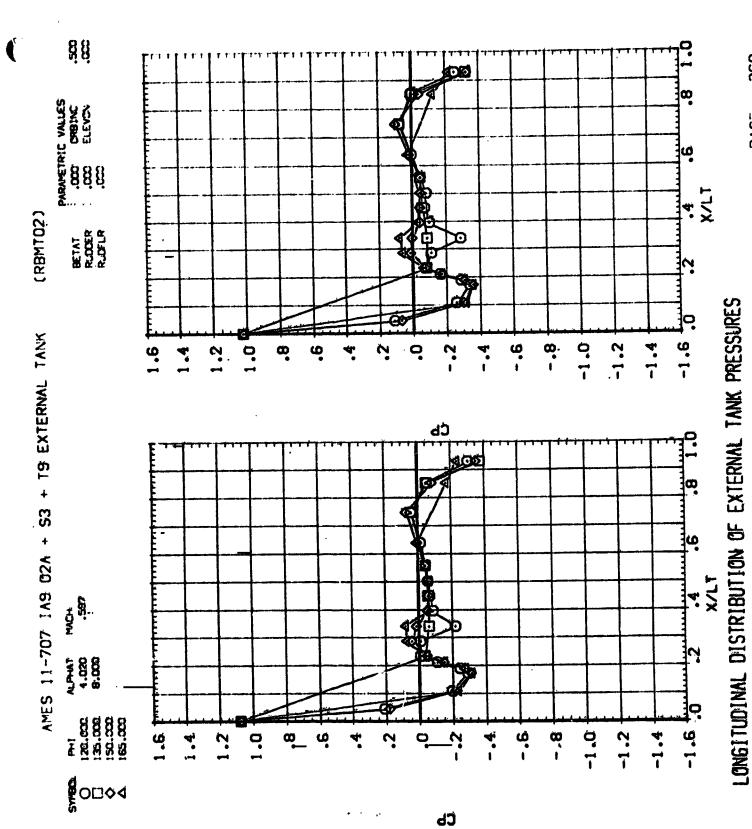
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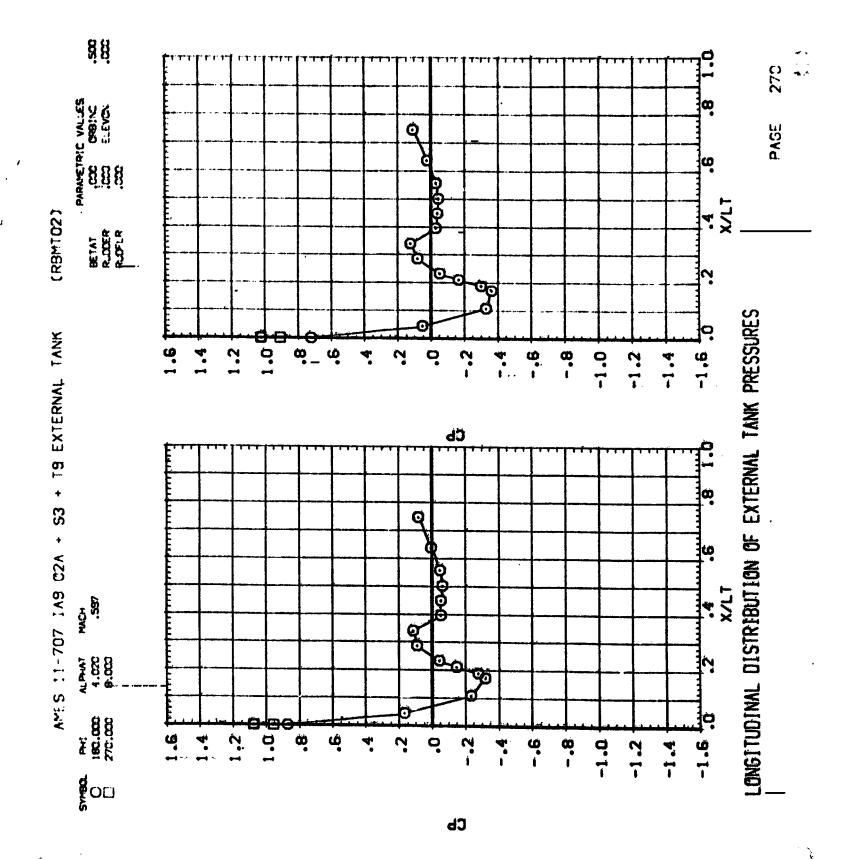
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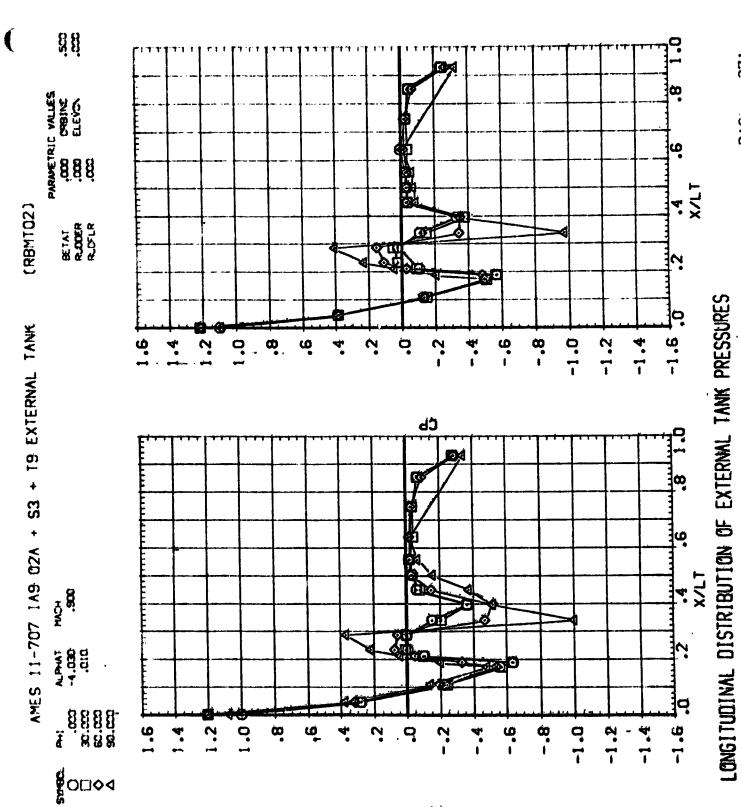
AMES 11-707 IA9 02A + S3 + T9 EXTERNAL TANK

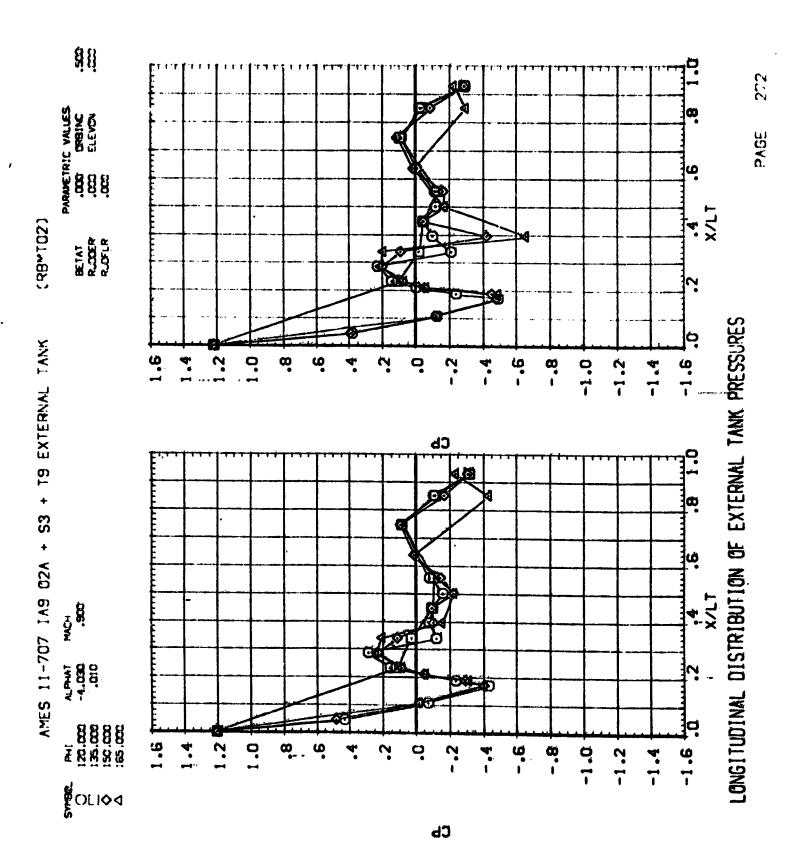


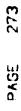


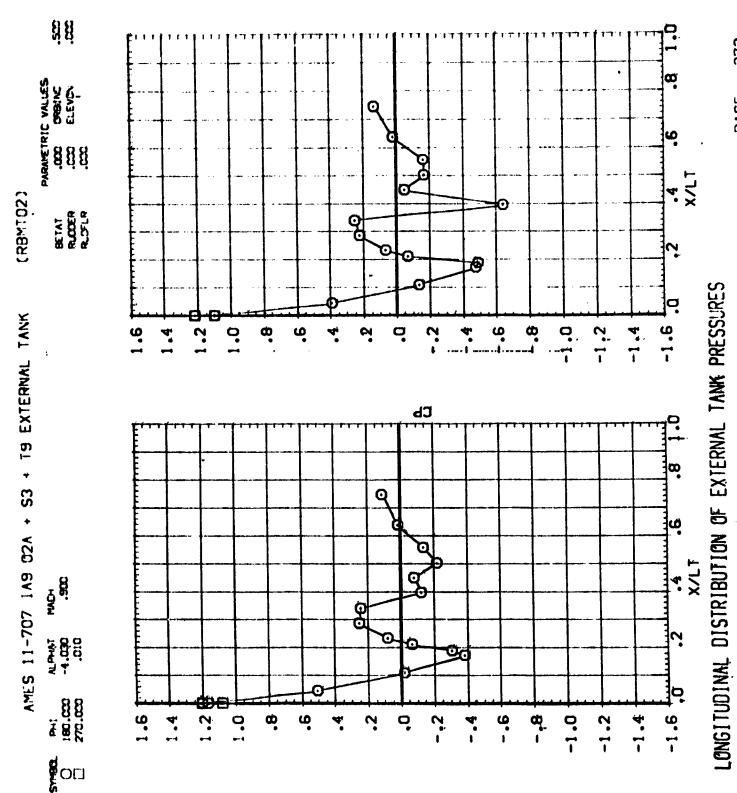




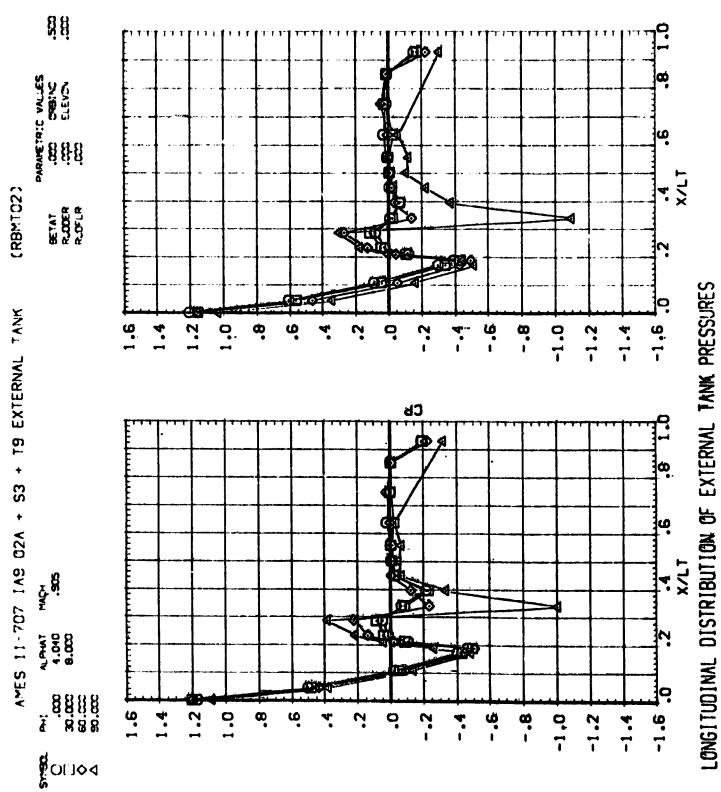




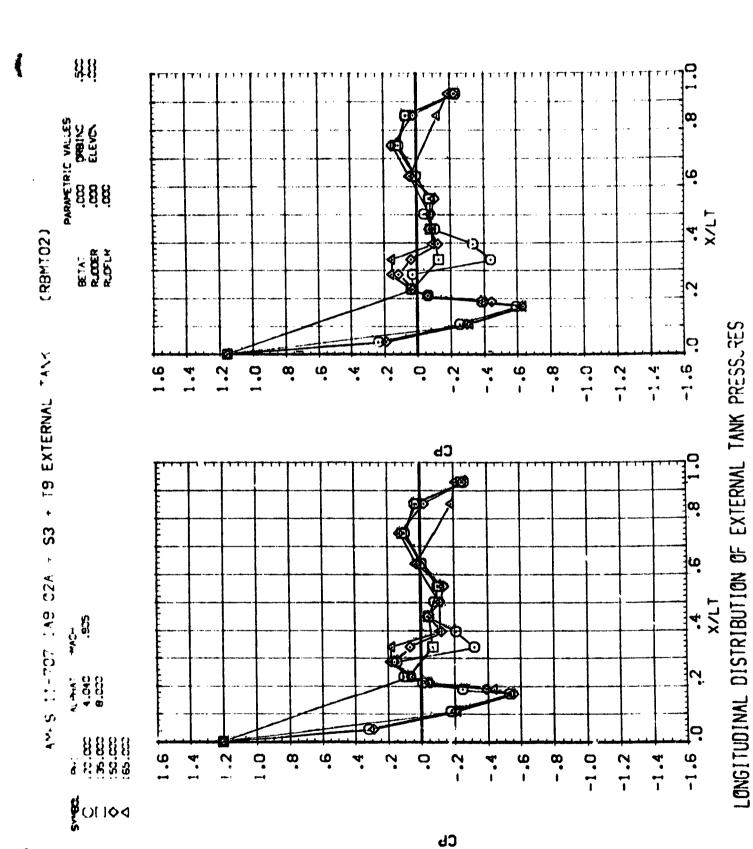




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LONGITUDINAL DISTRIBUTION OF EXTERNAL TANK PRESSURES

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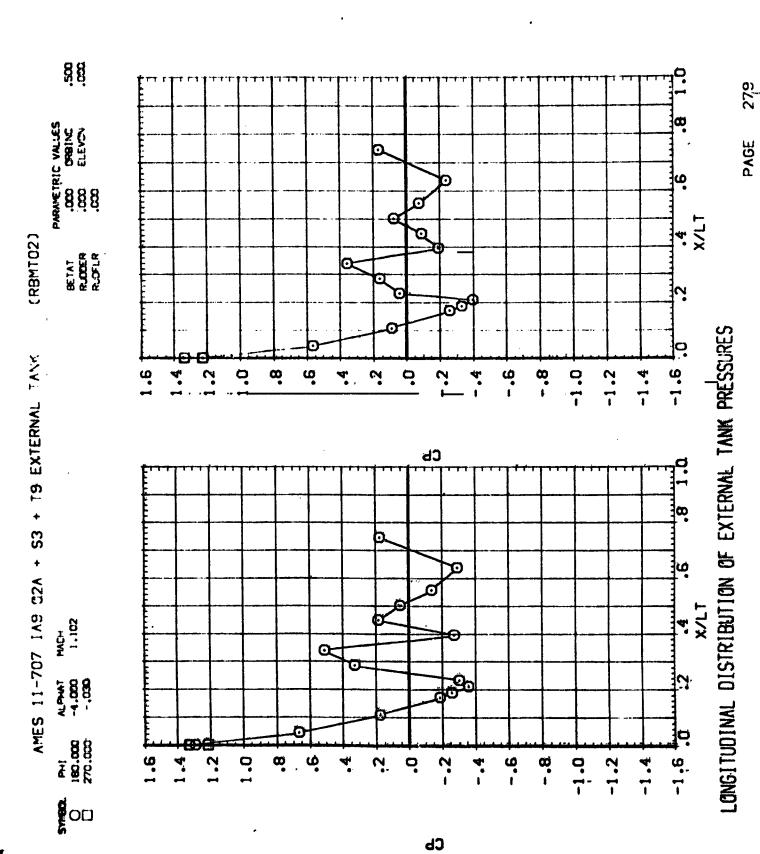
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LONGITUDINAL DISTRIBUTION OF EXTERNAL TANK PRESSURES

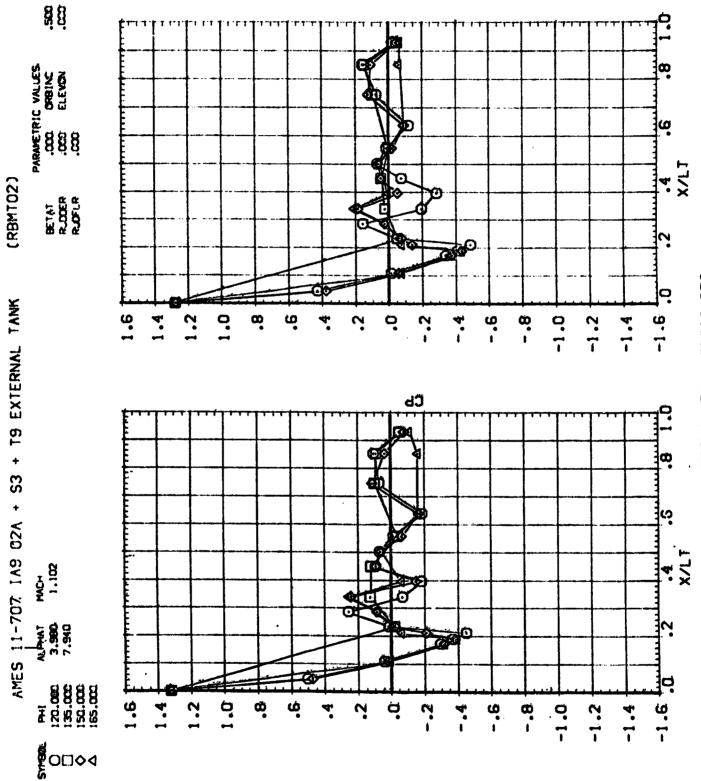
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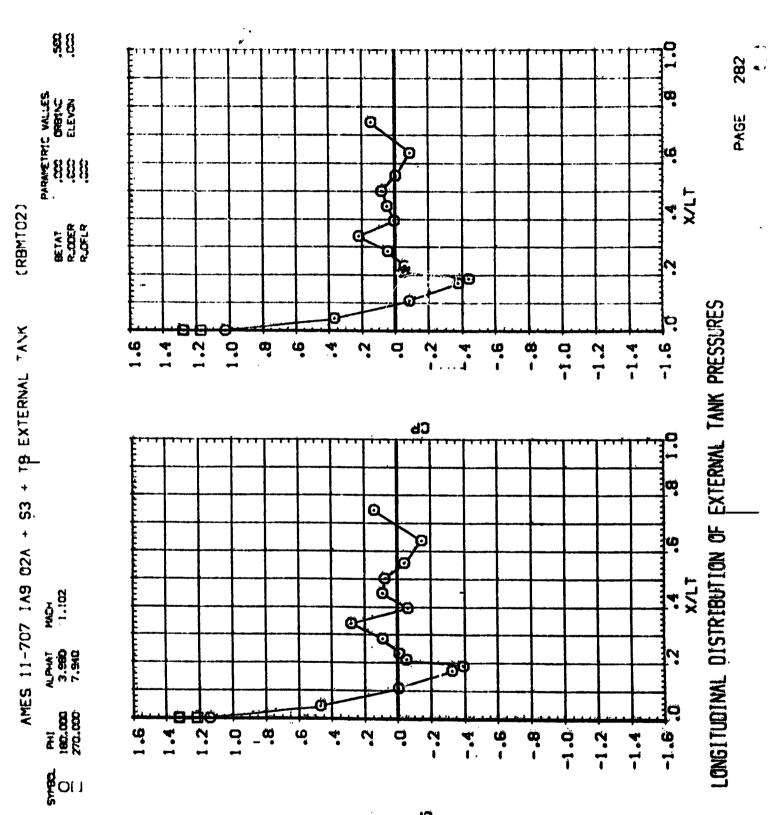
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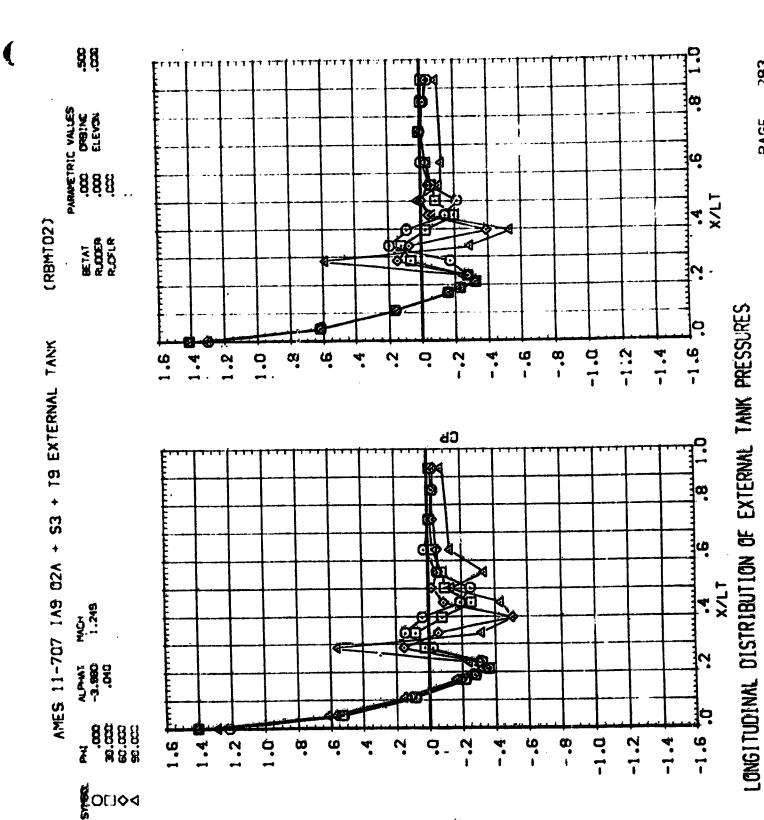
LONGITUDINAL DISTRIBUTION OF EXTERNAL TANK PRESSURES

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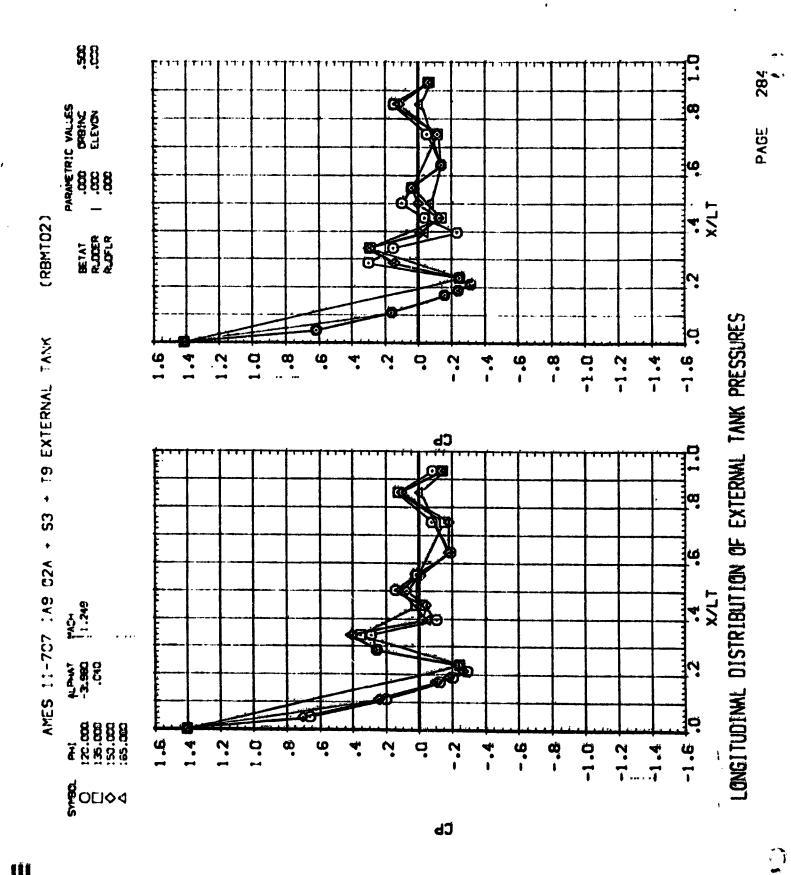
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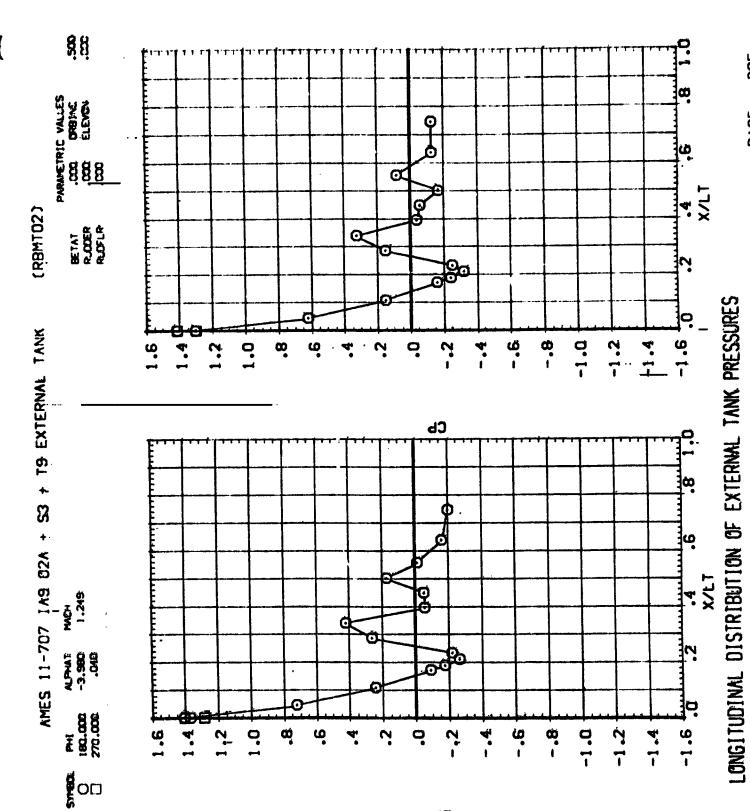


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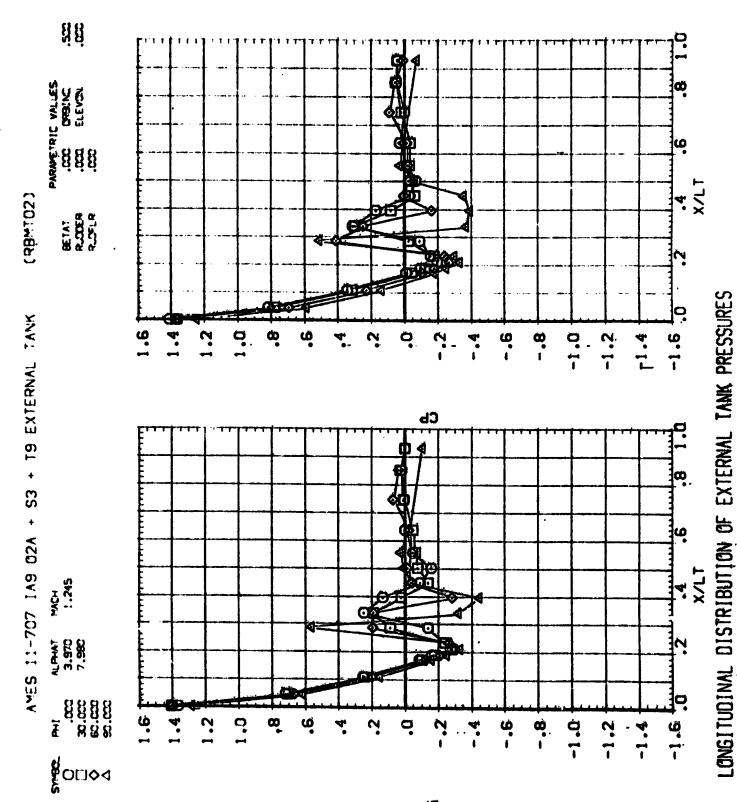




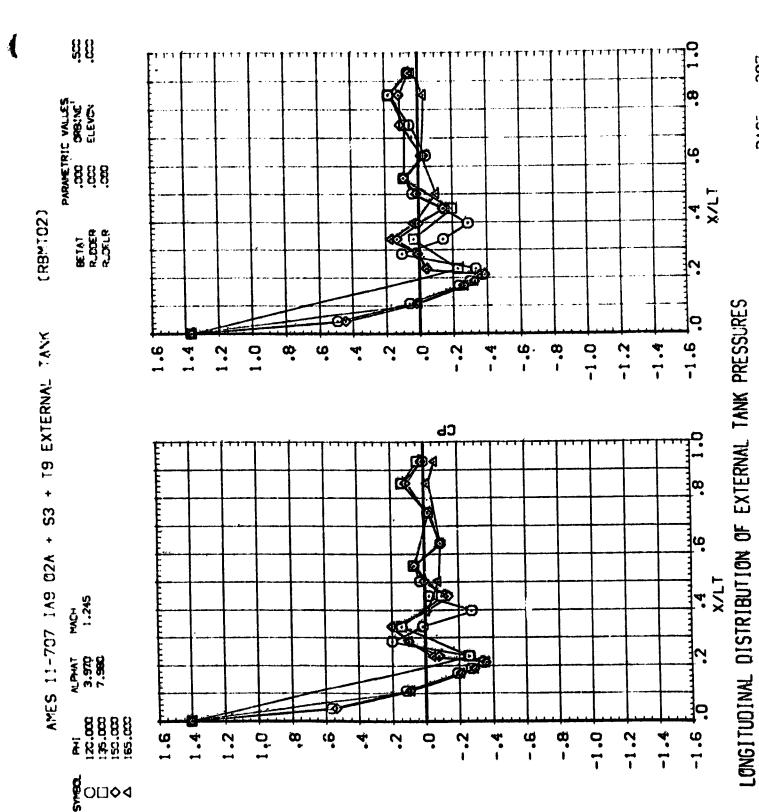
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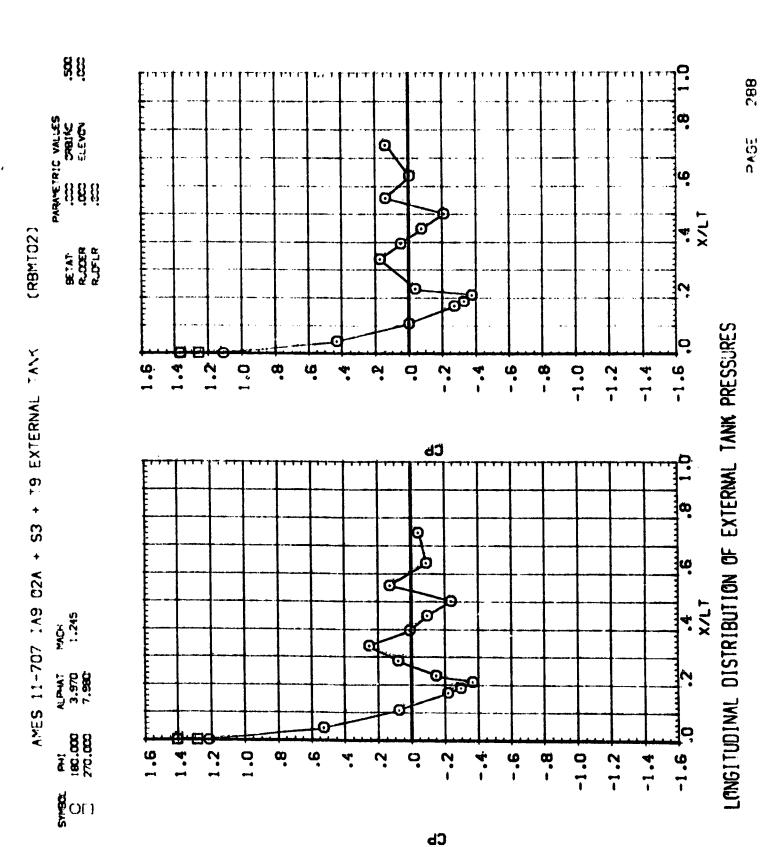






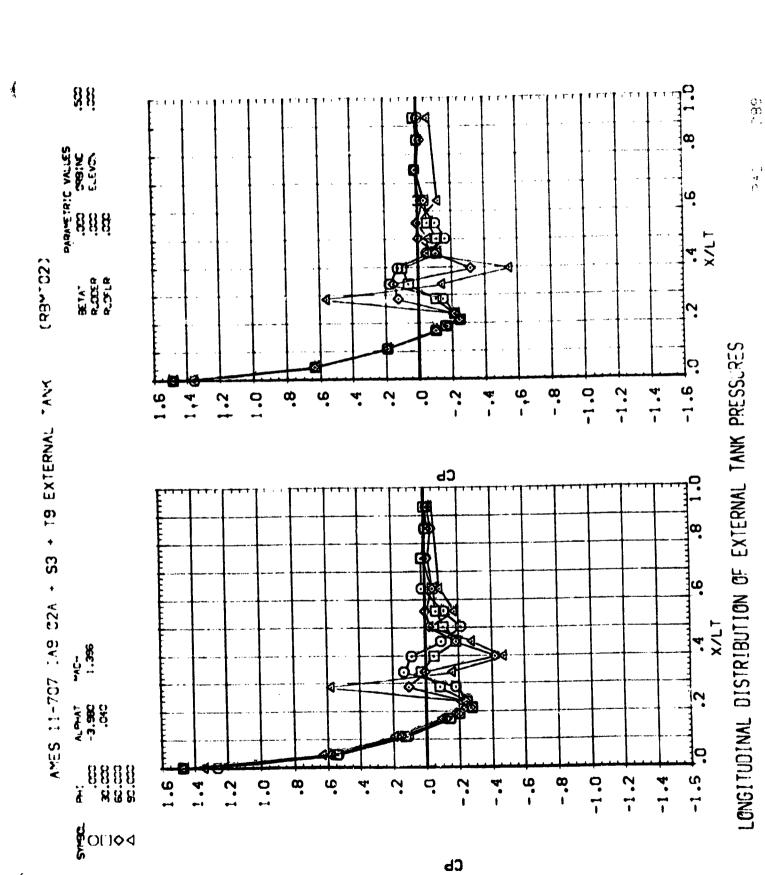
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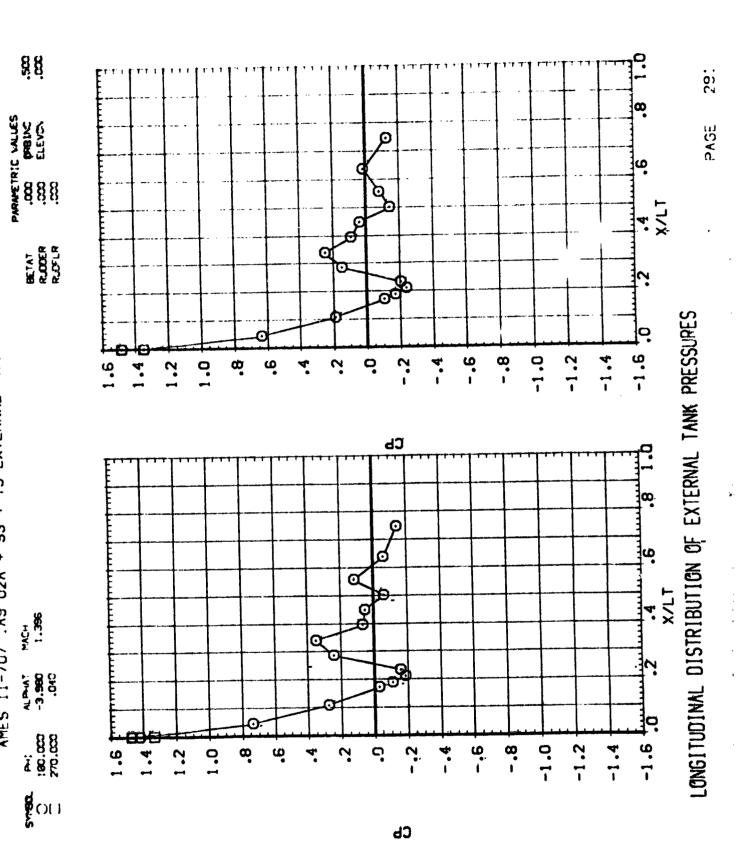




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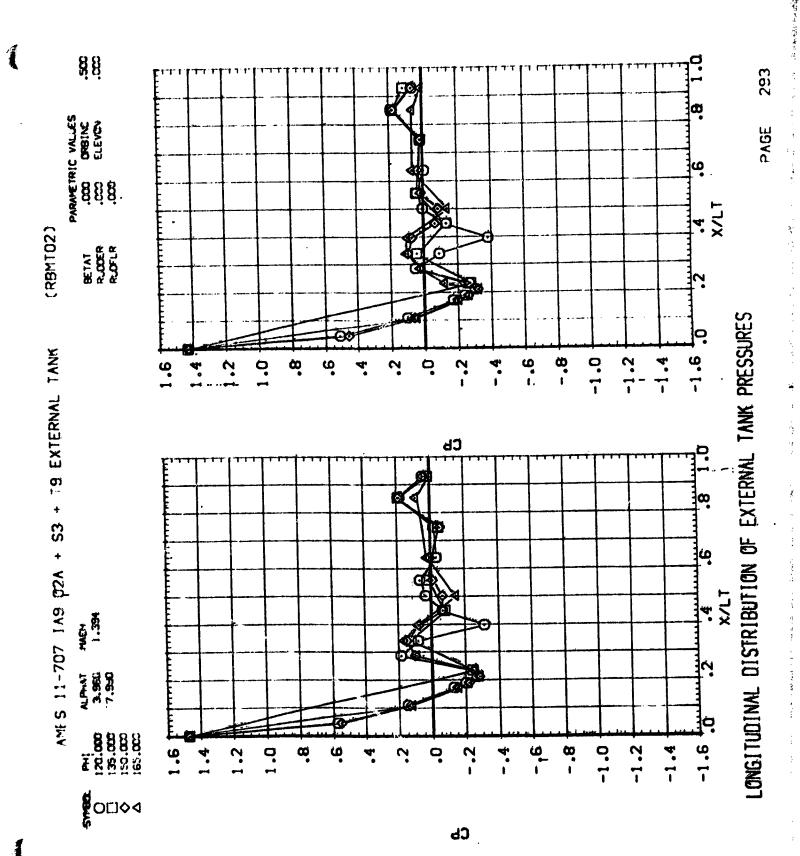




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AMES 11-707 : A9 02A + S3 + T9 EXTERNAL TANK

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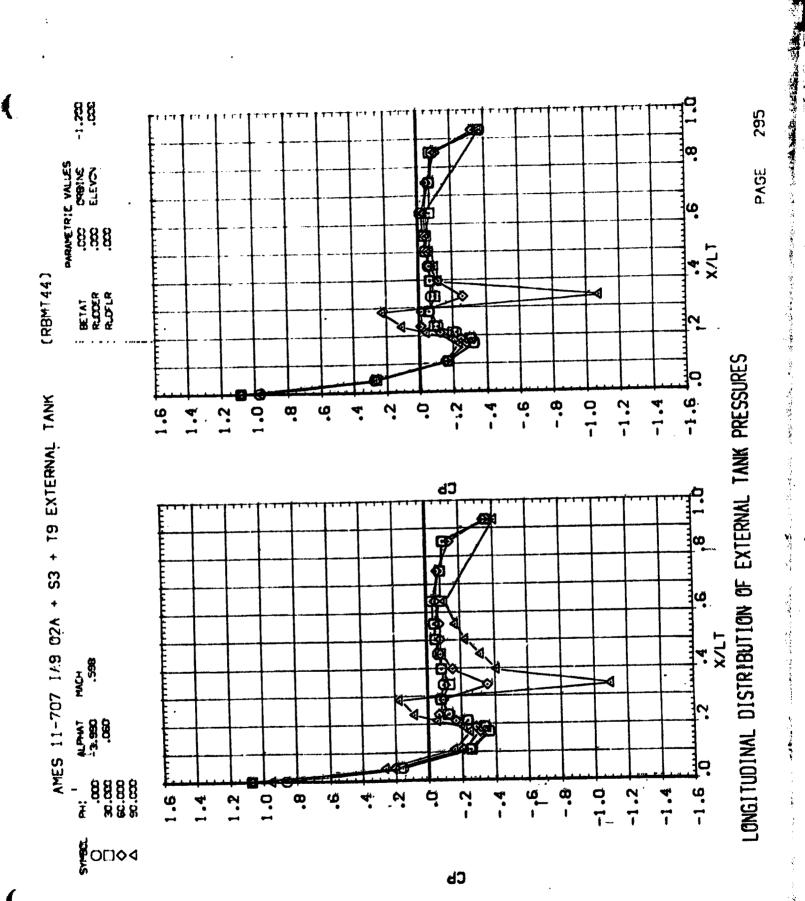
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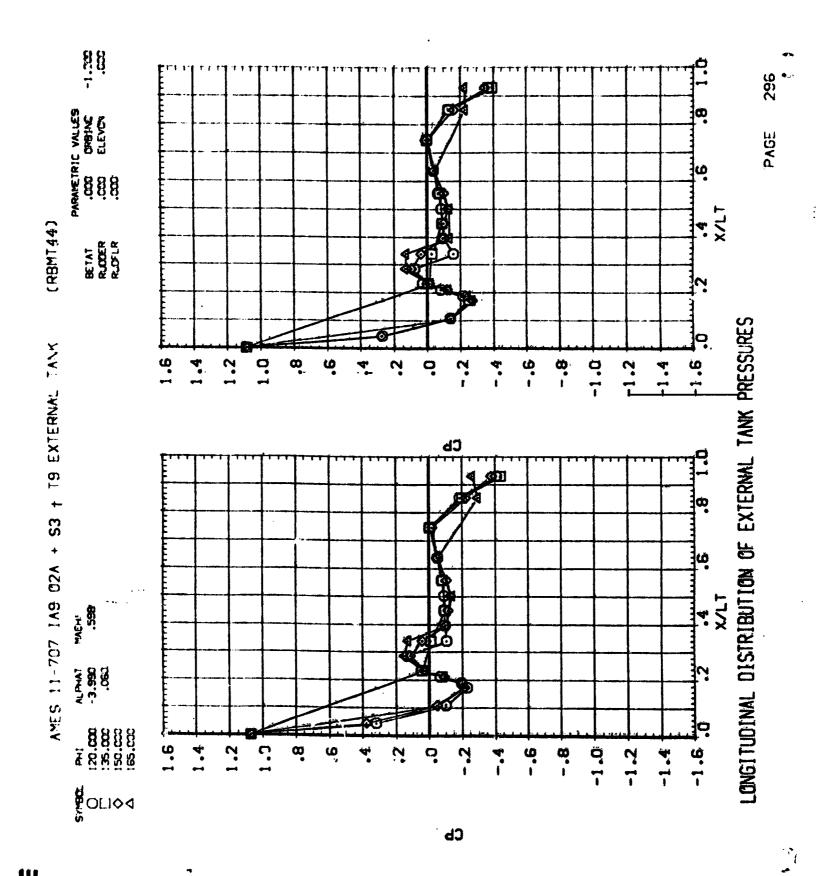
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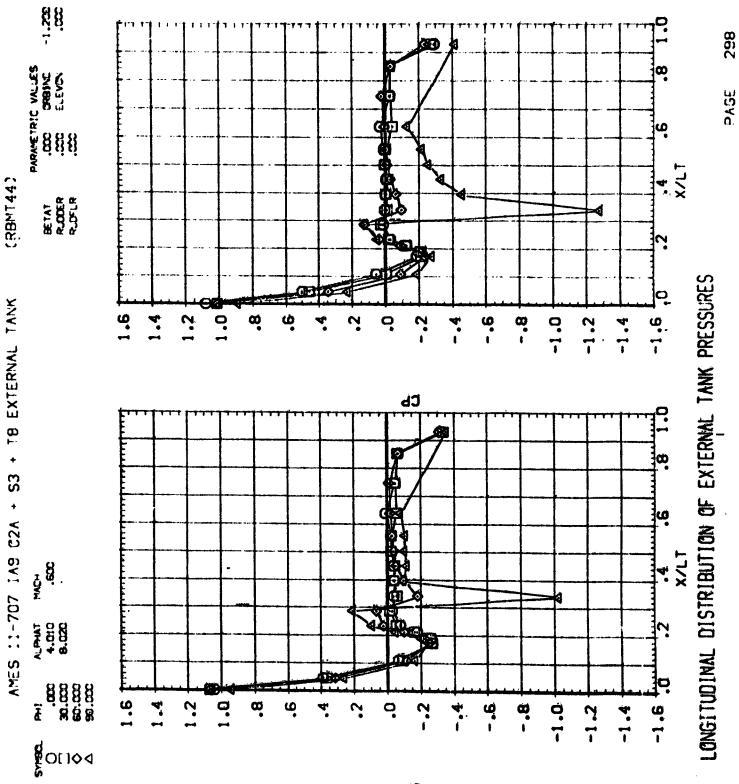
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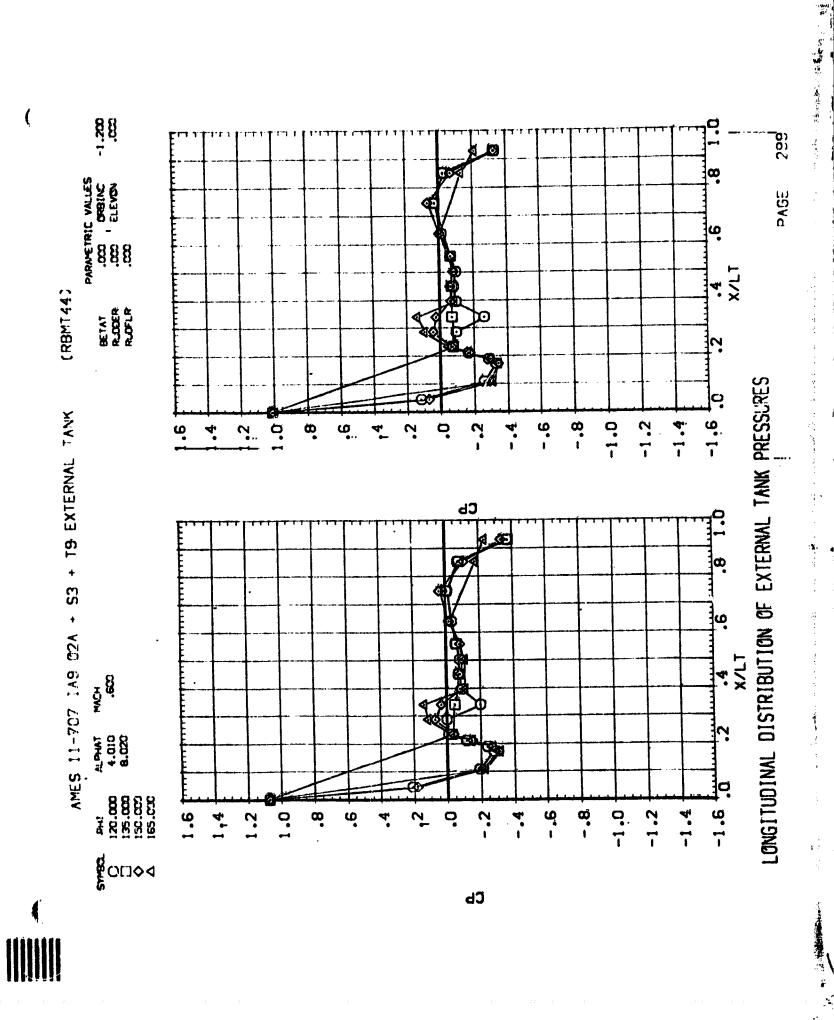
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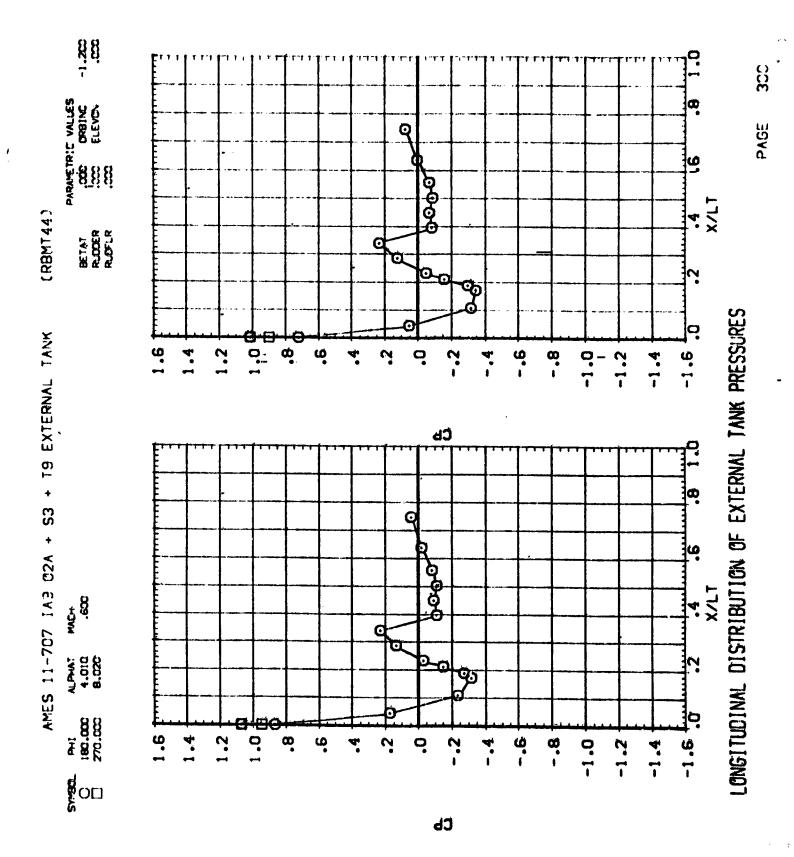
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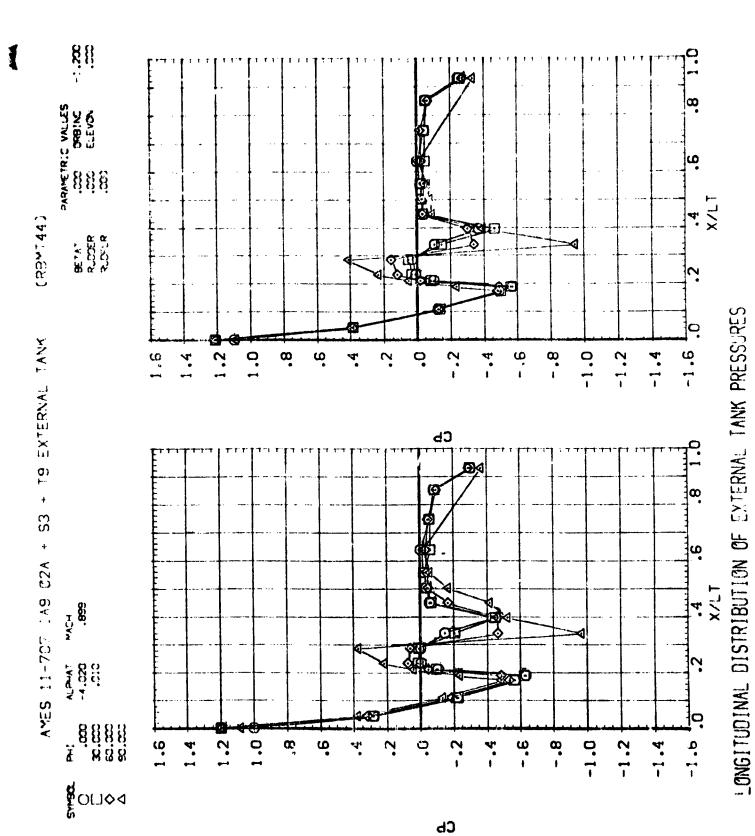
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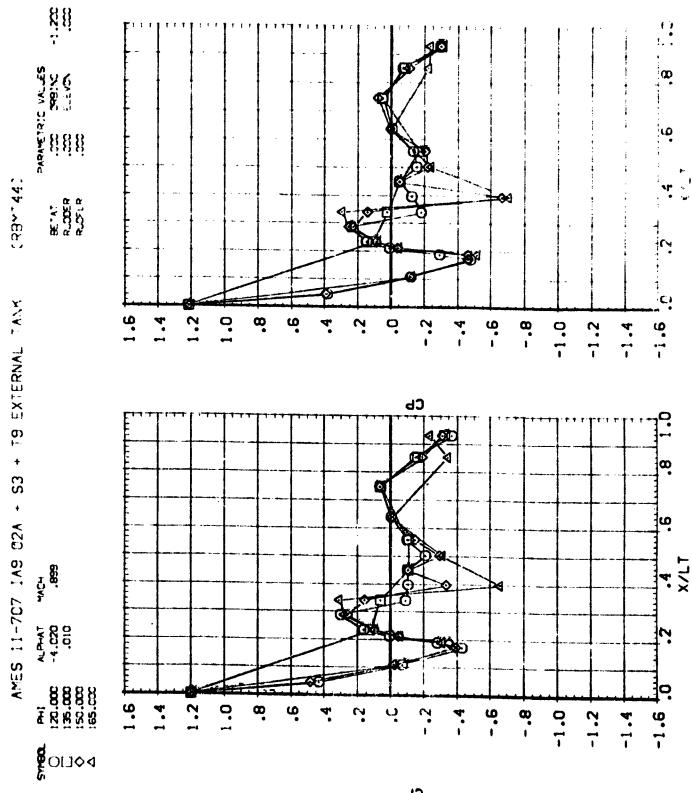
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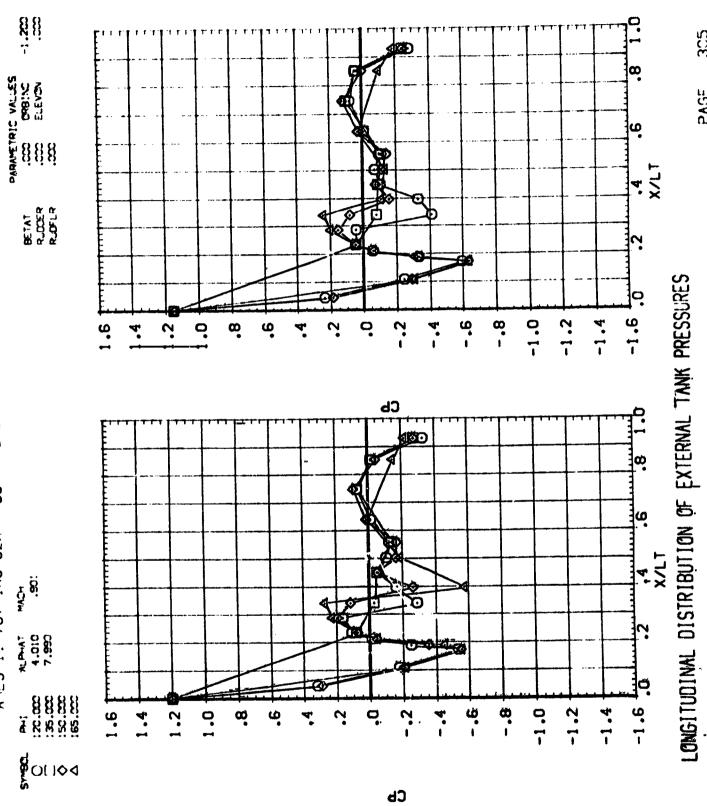
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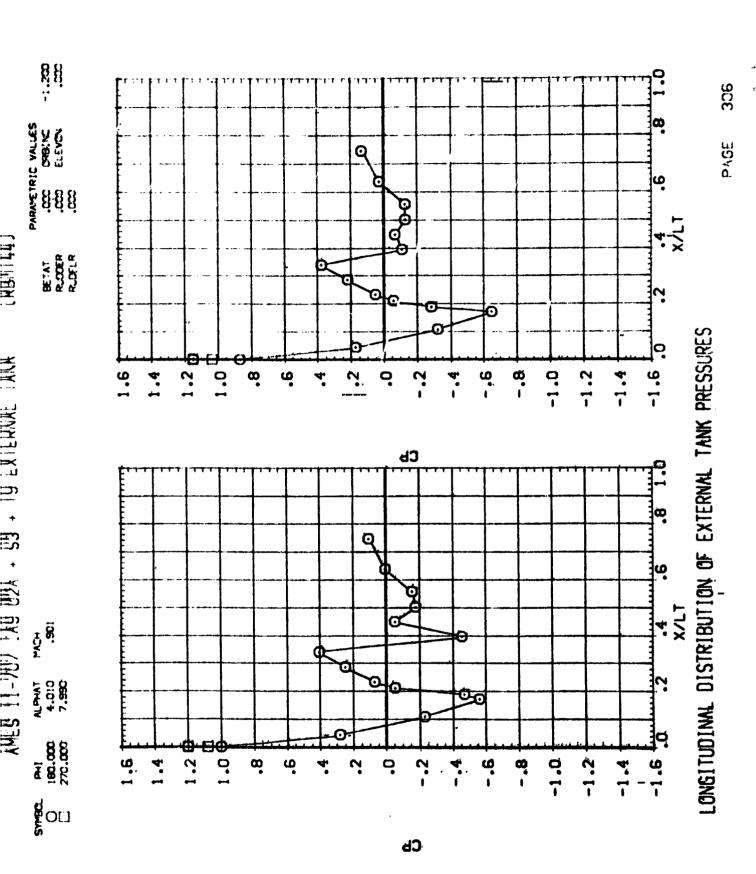
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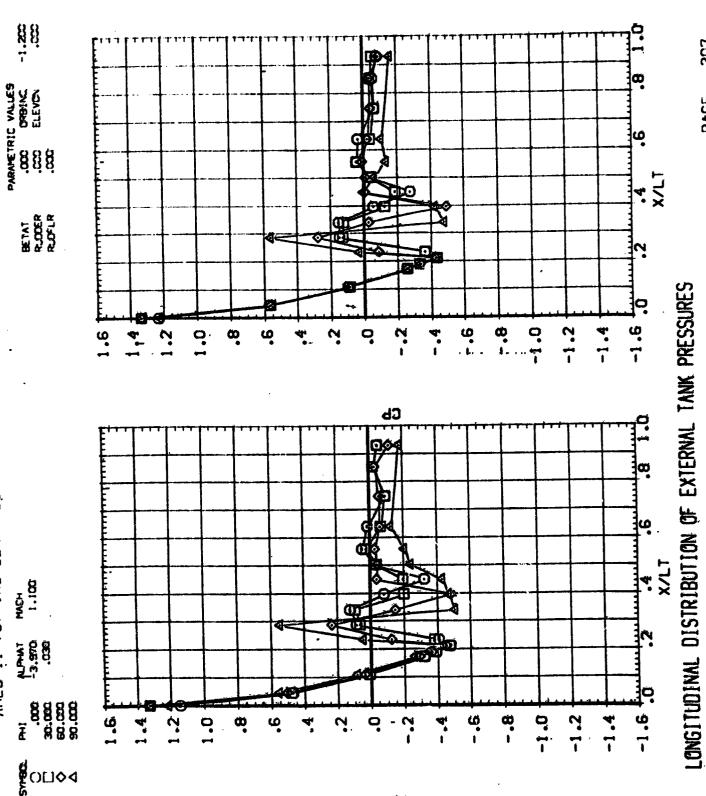
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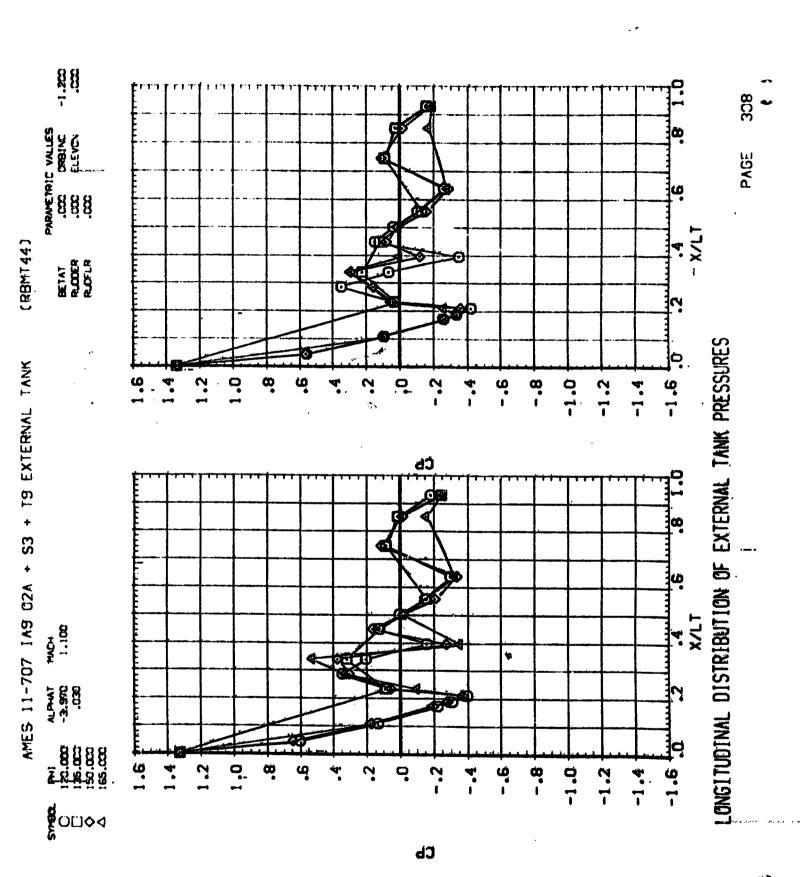


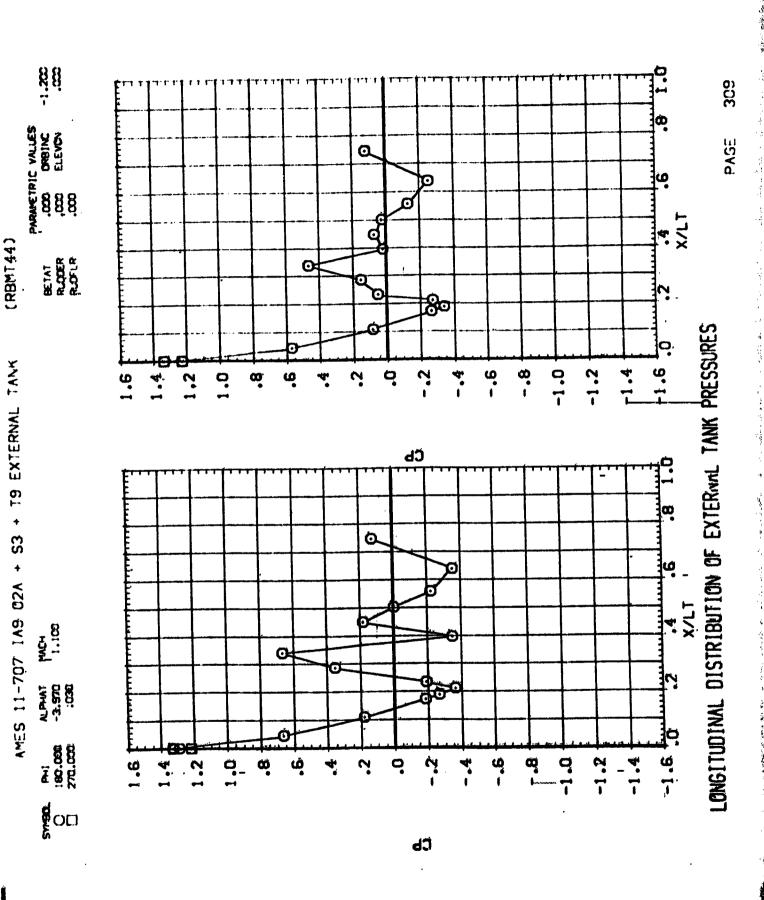


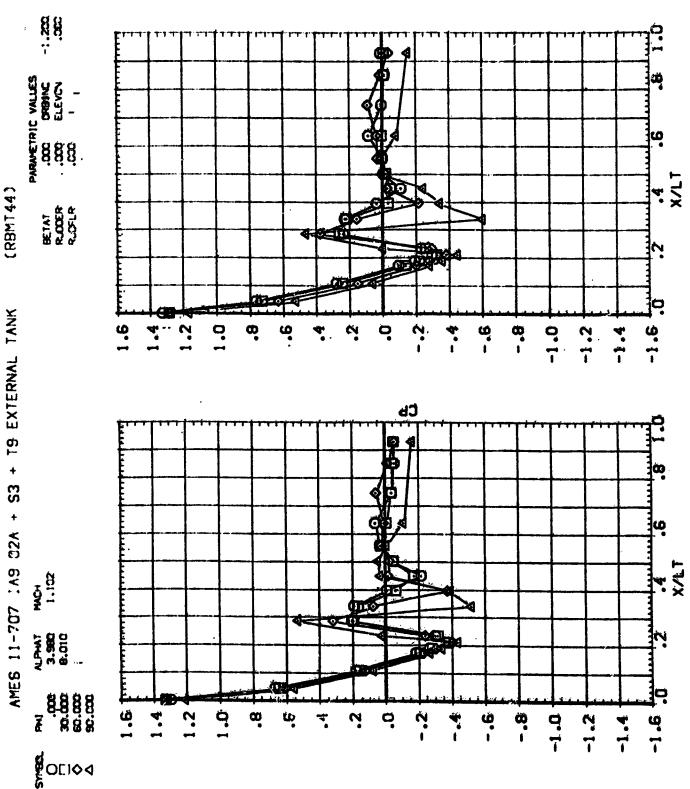
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AMES 11-707 IA9 02A + S3 + T9 EXTERNAL TANK

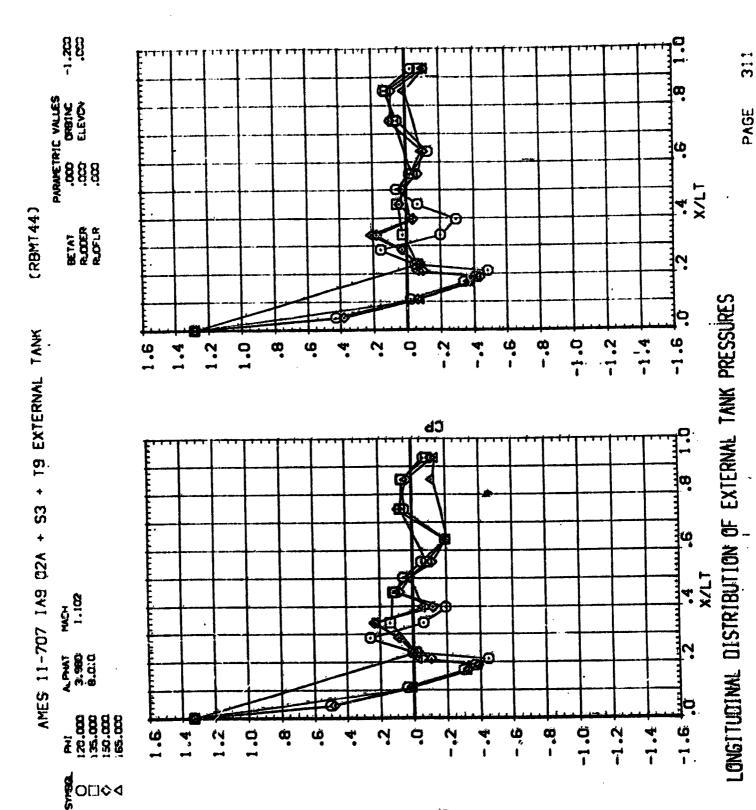






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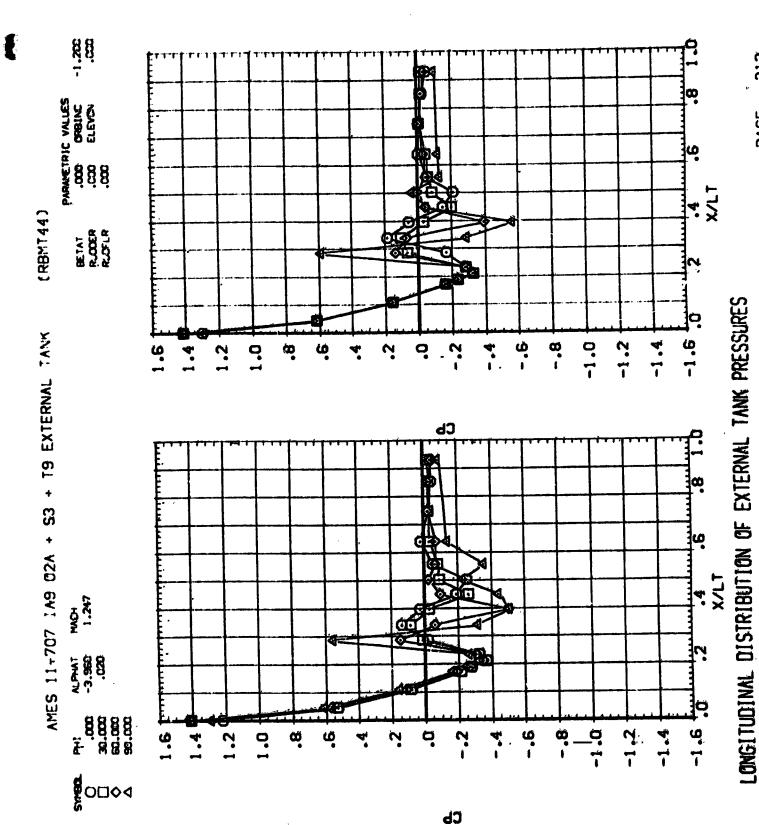
AMES 11-707 IA9 32A + S3 + T9 EXTERNAL TANK

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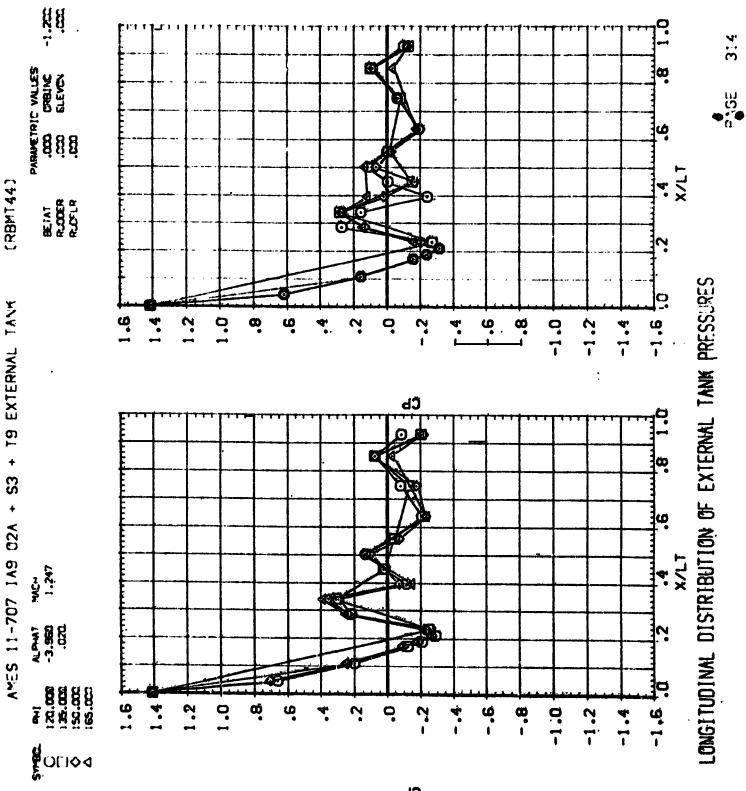
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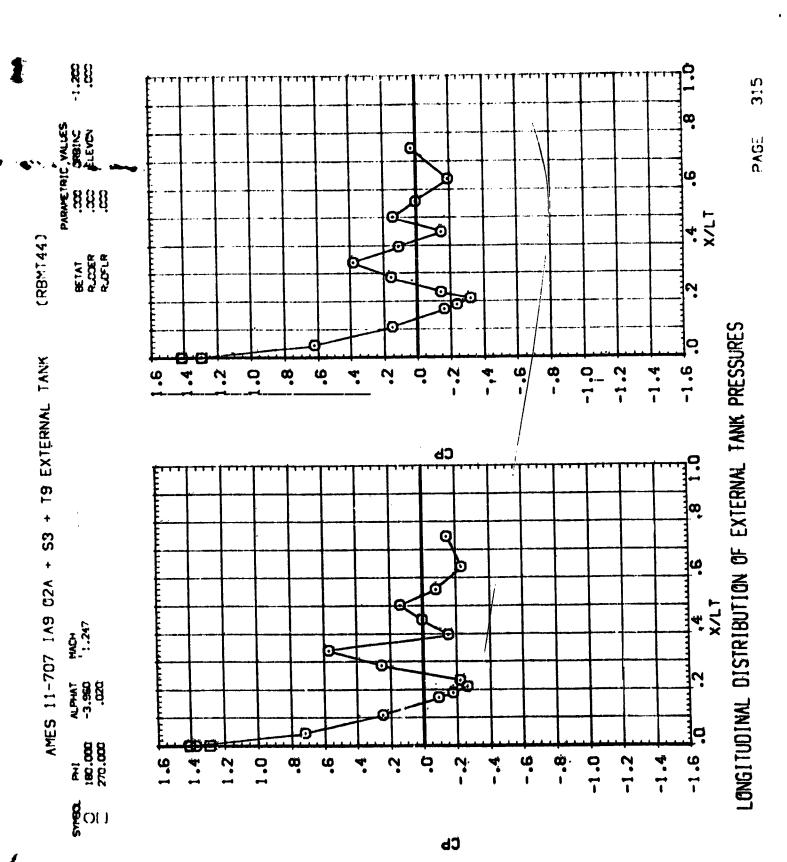
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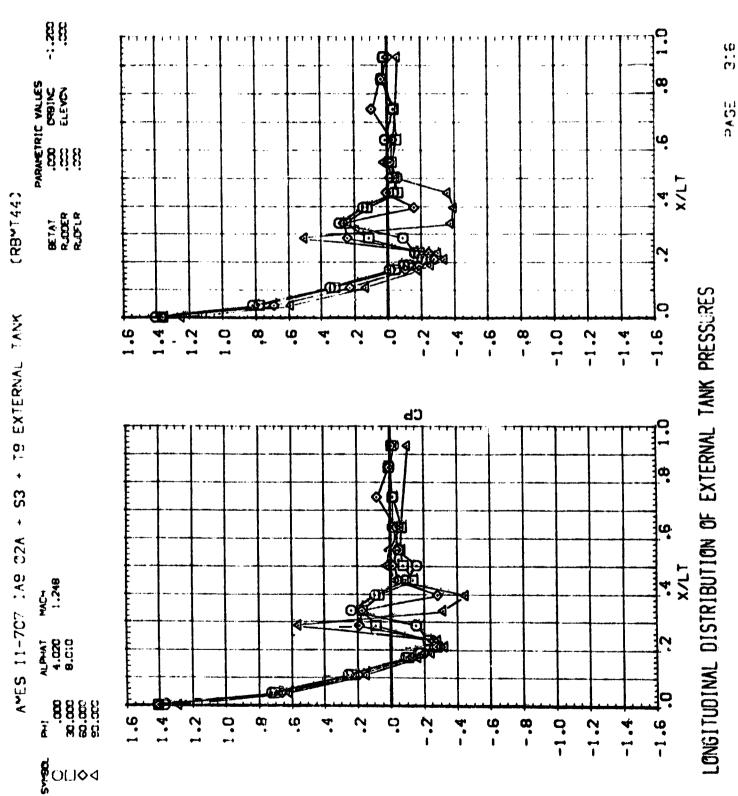
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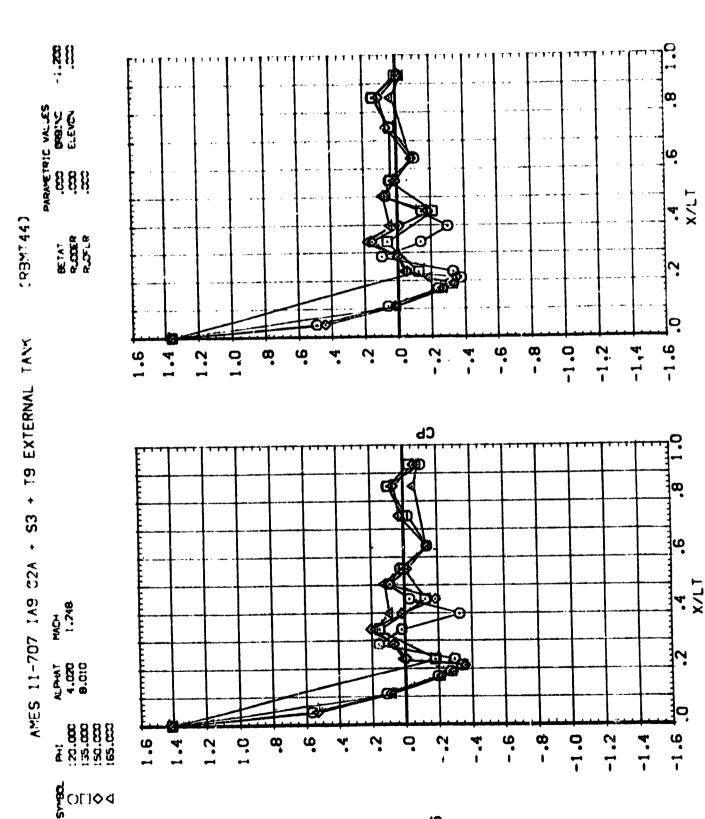
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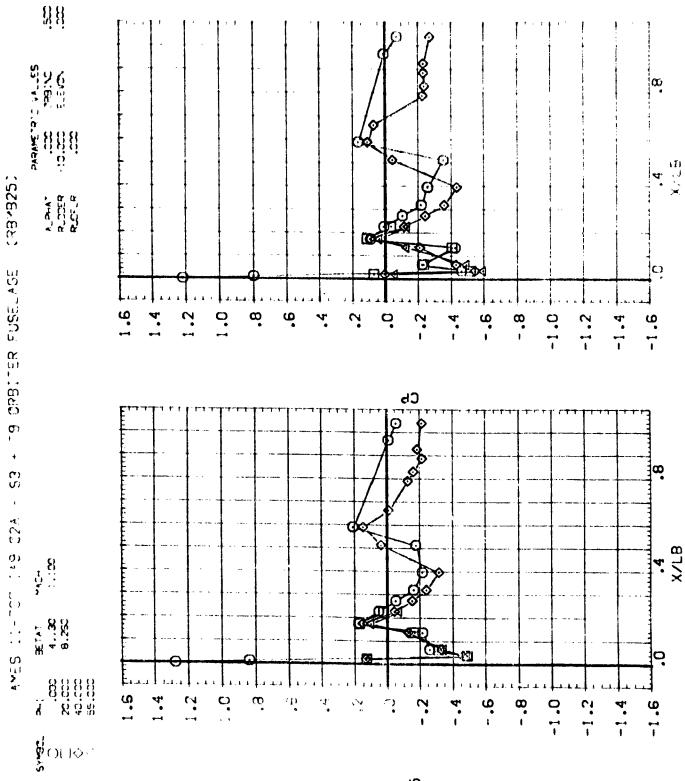


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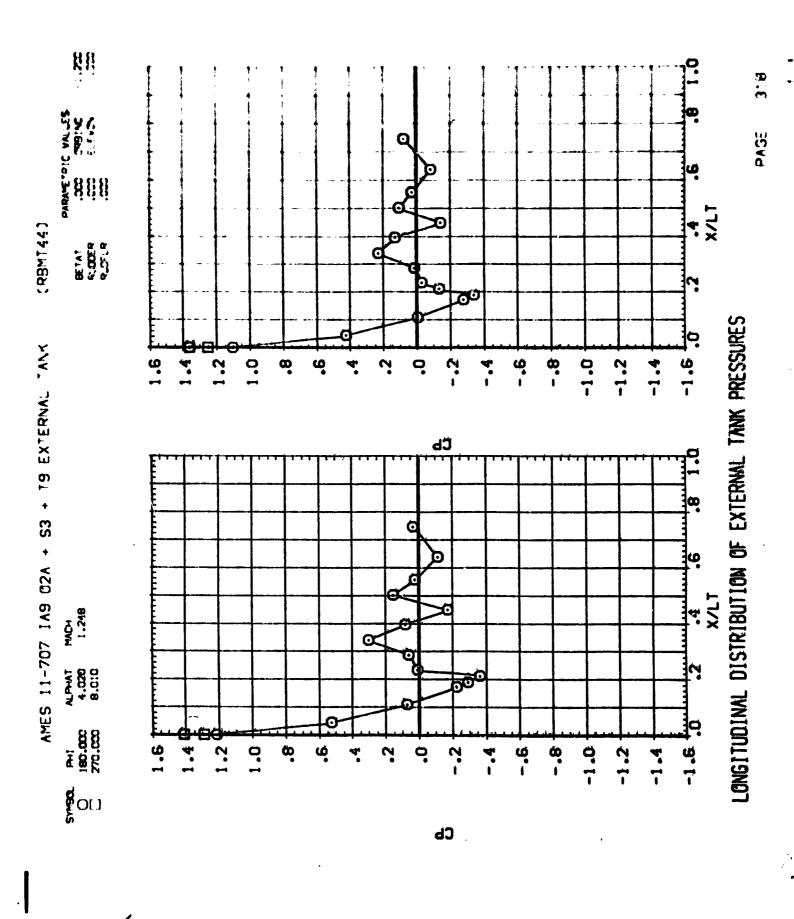


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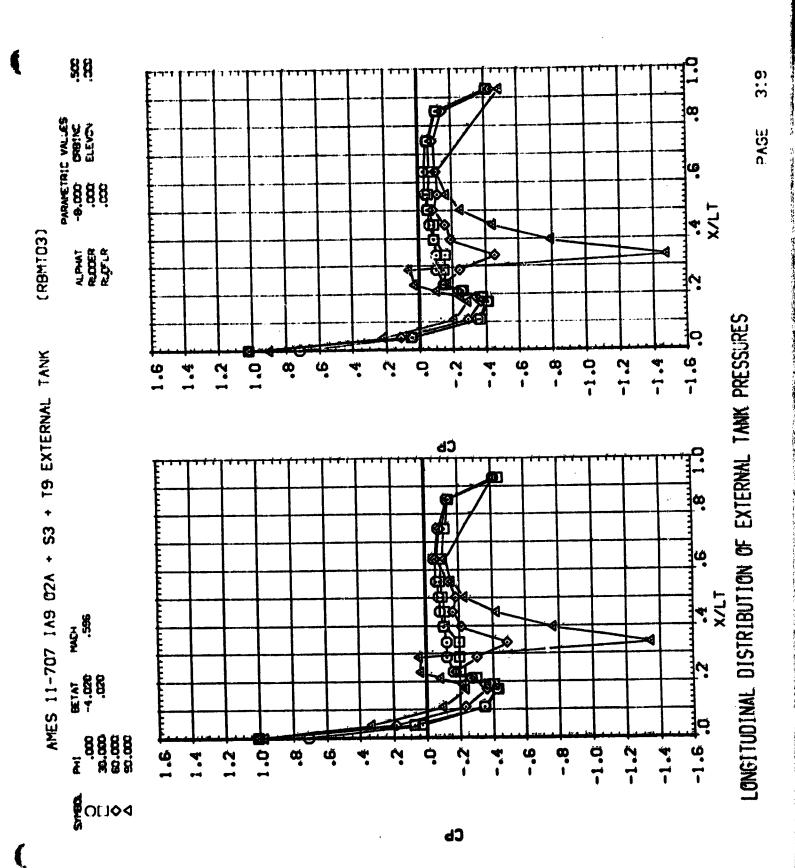
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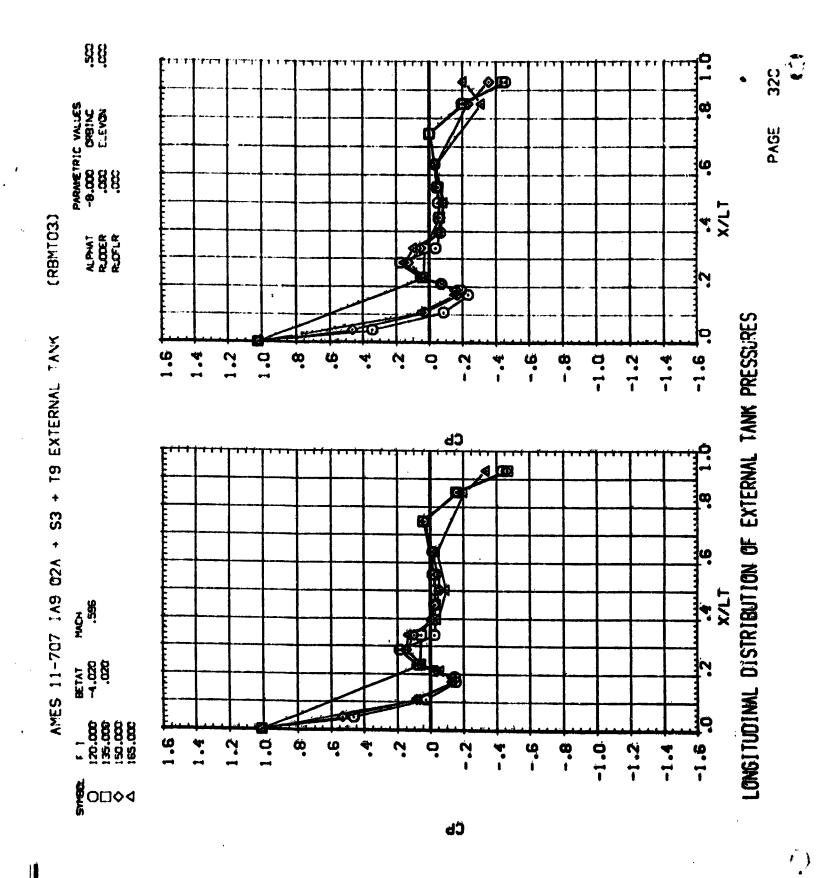


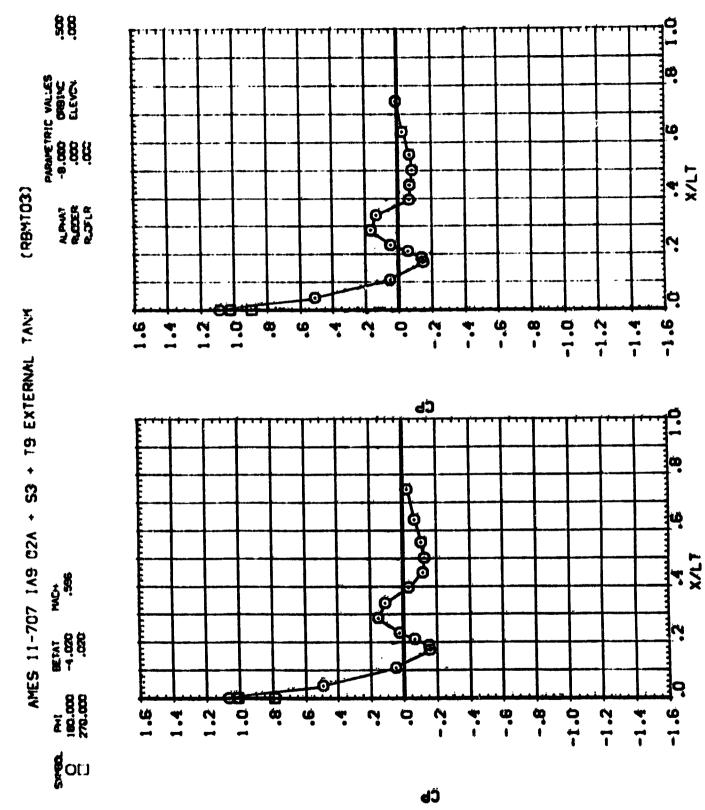
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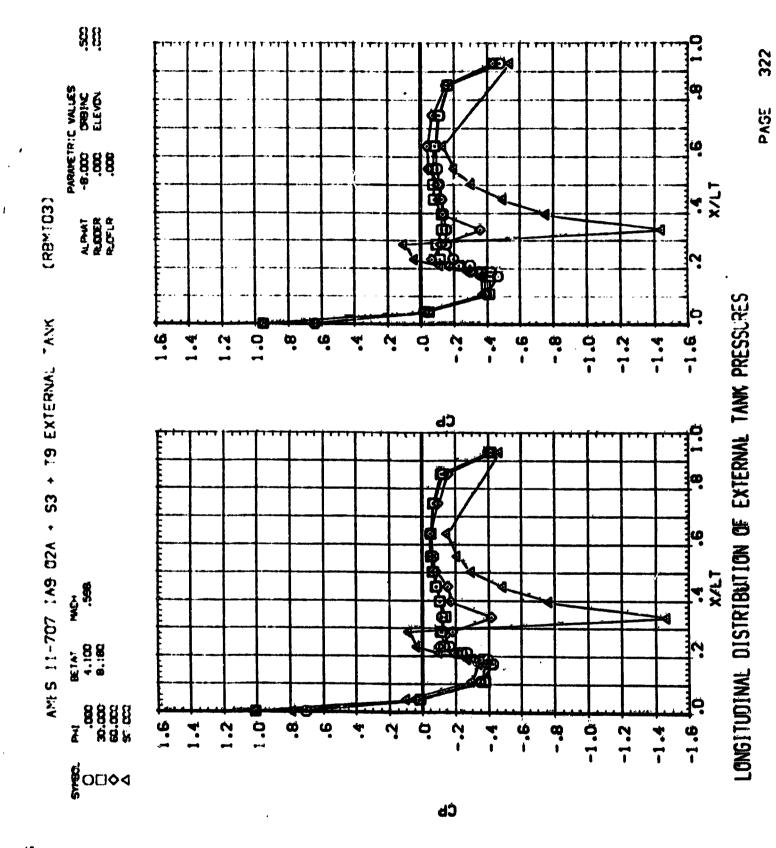
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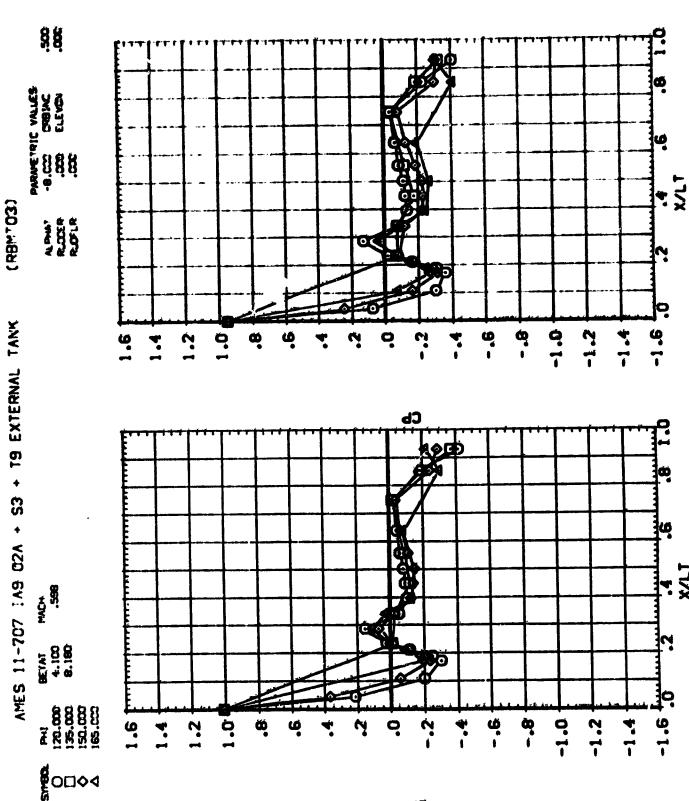


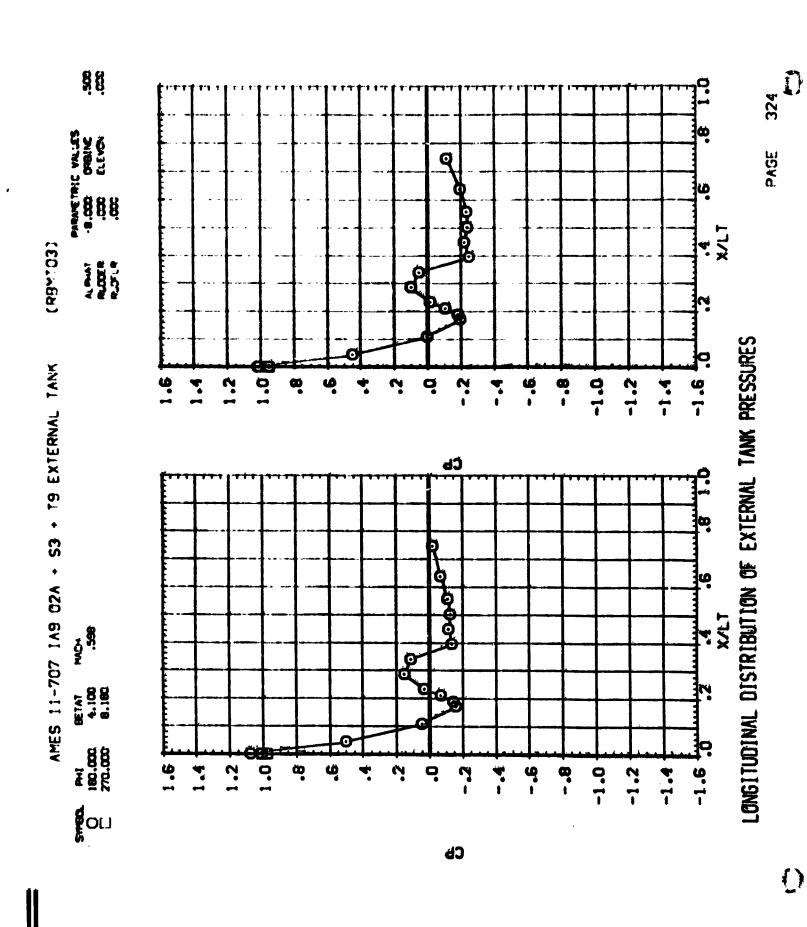


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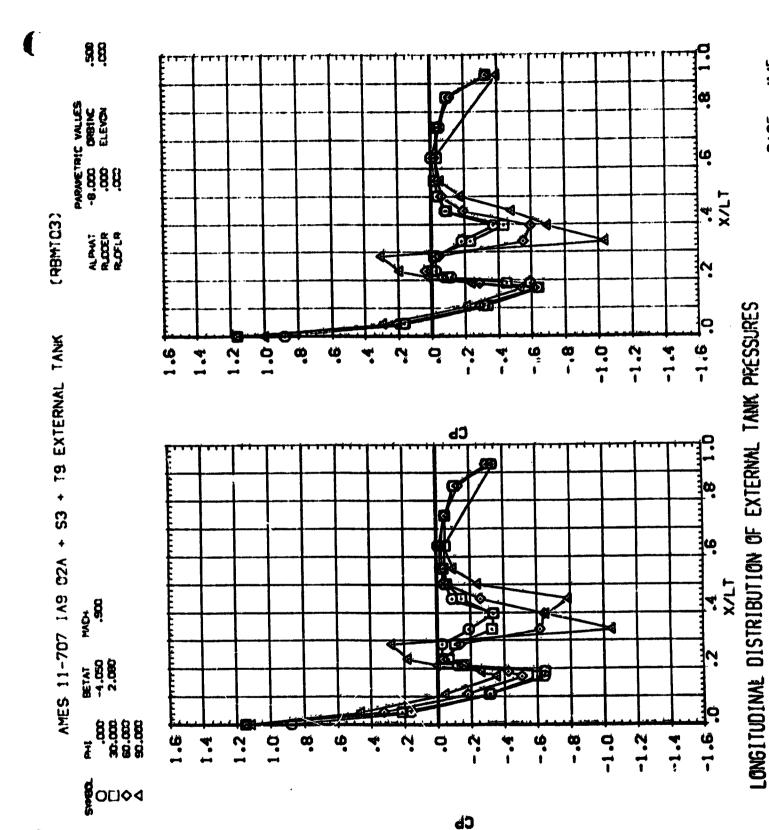






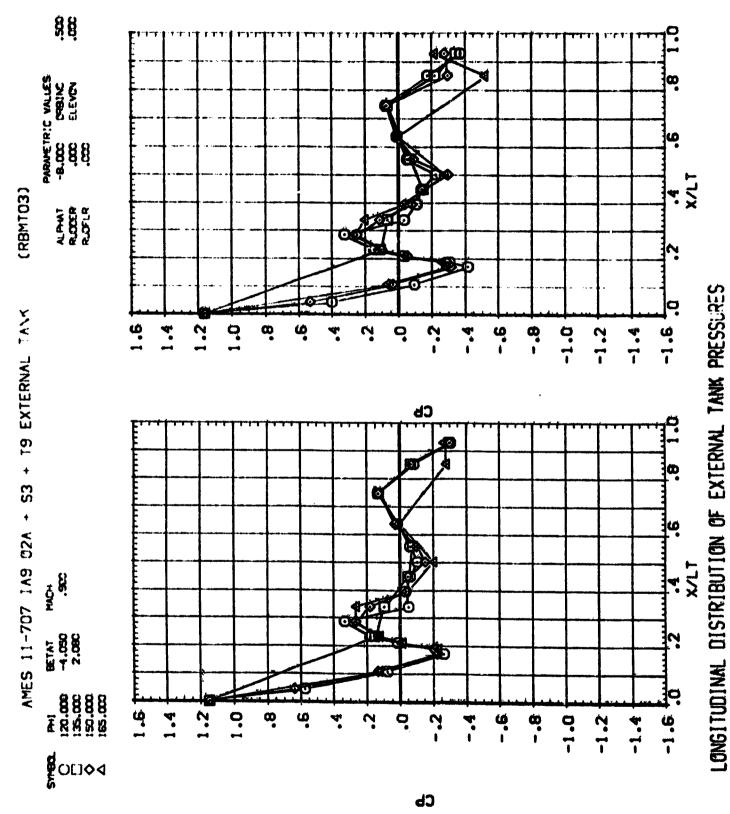


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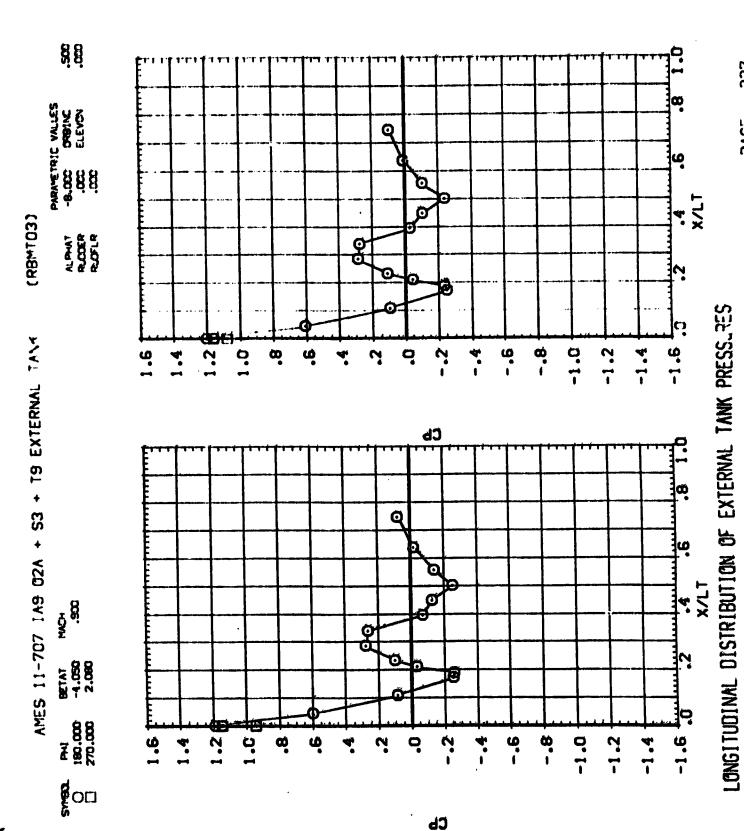




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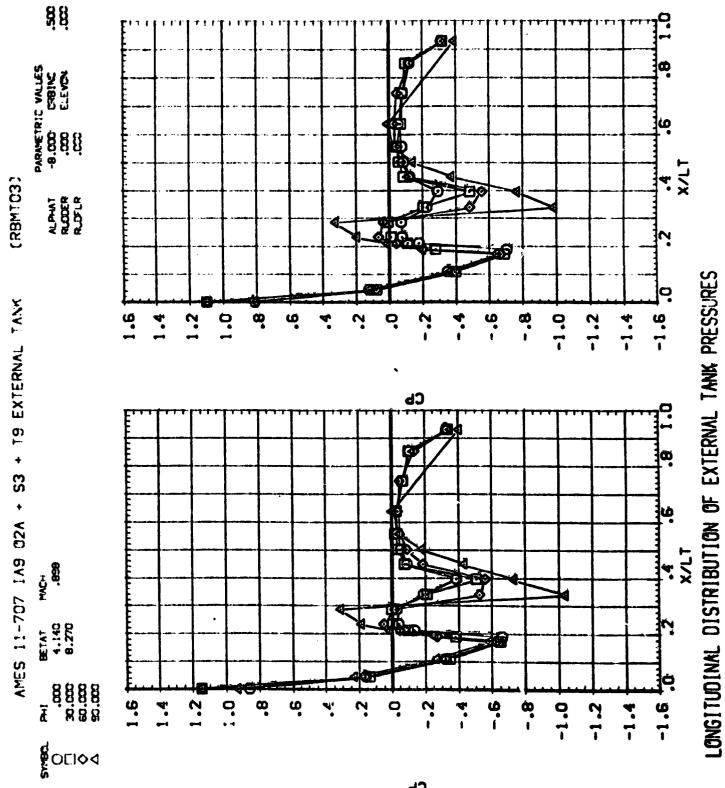


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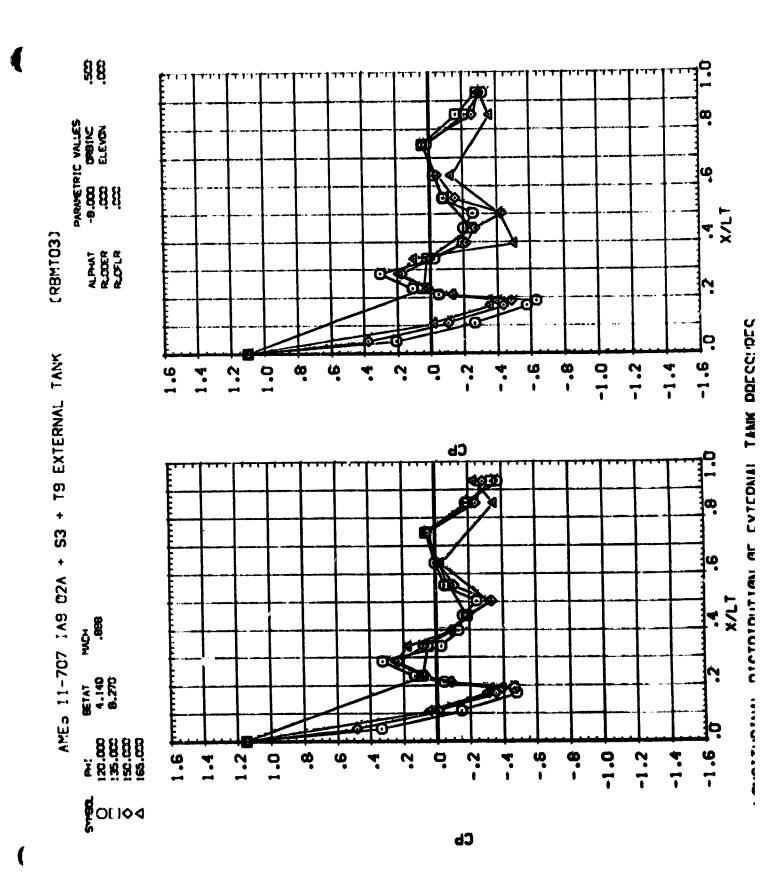


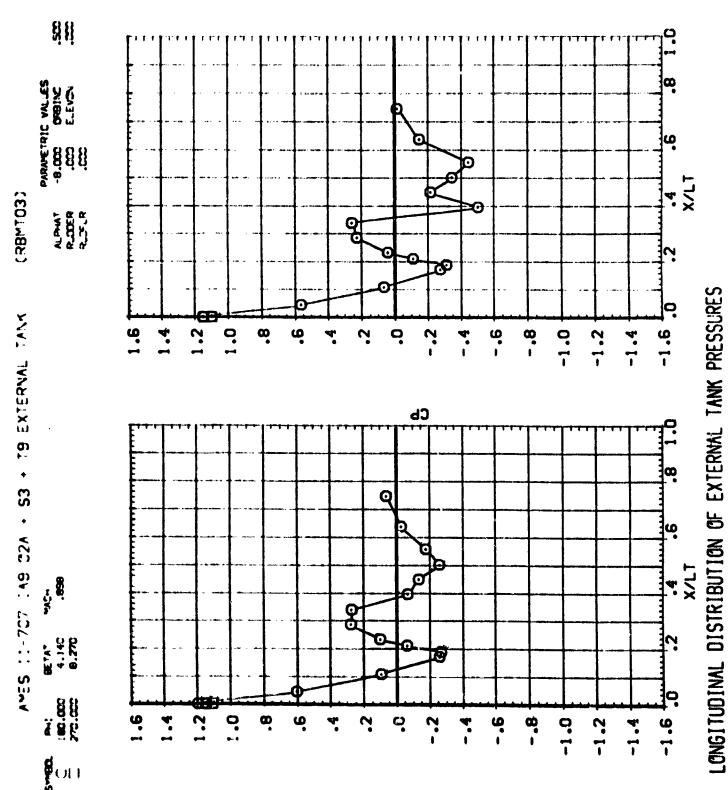


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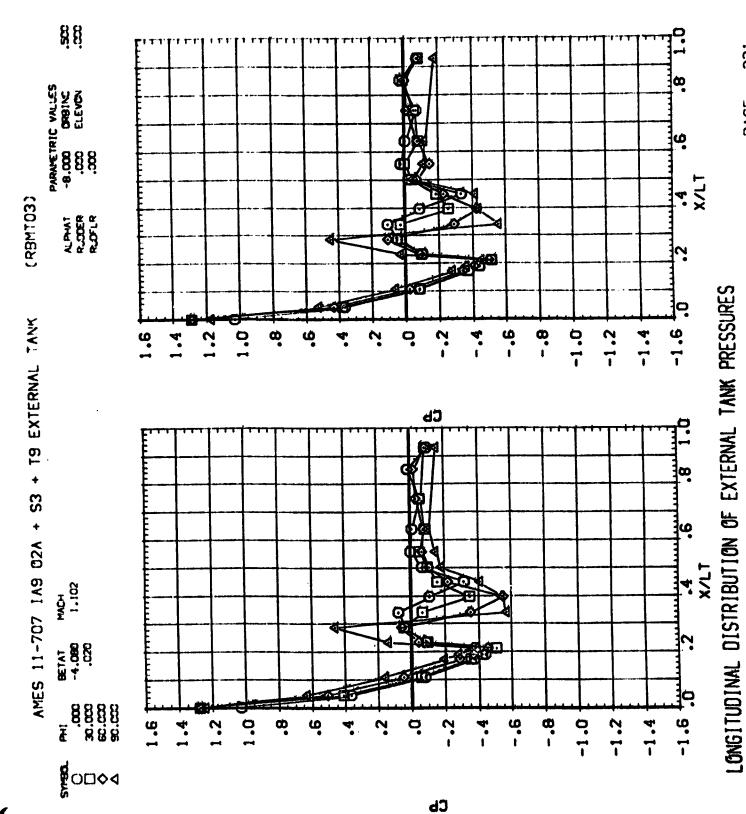


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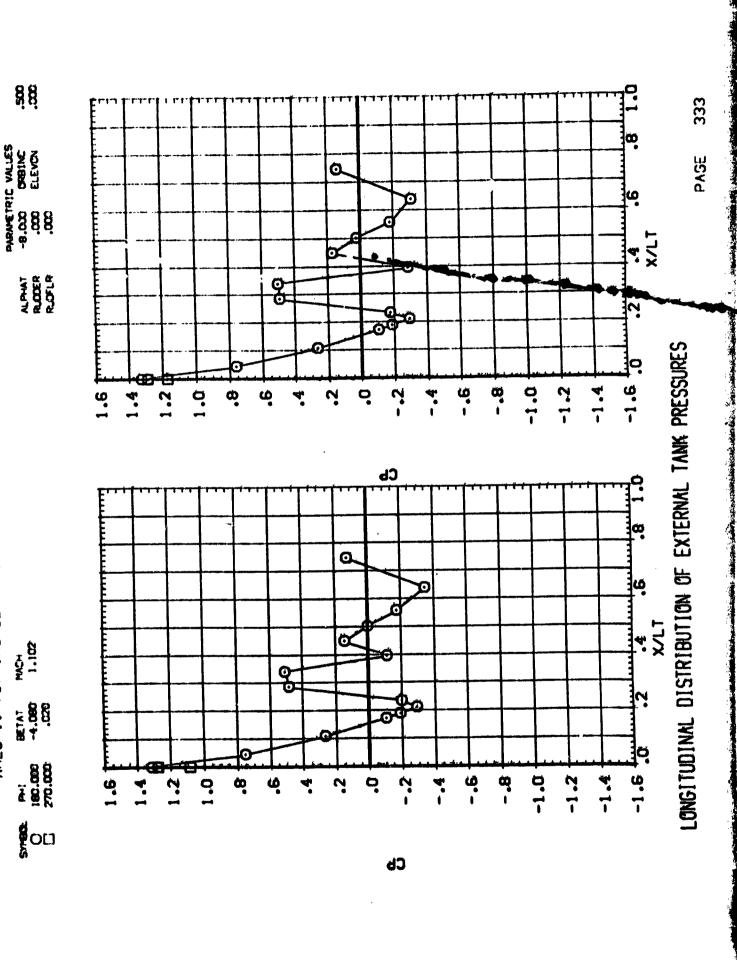




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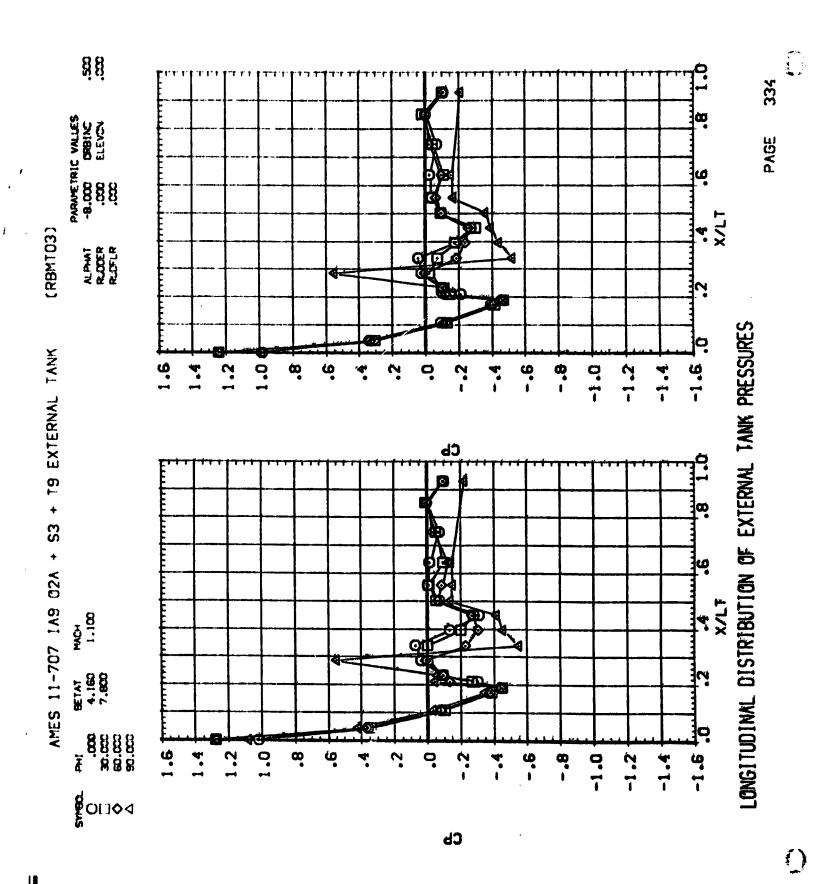


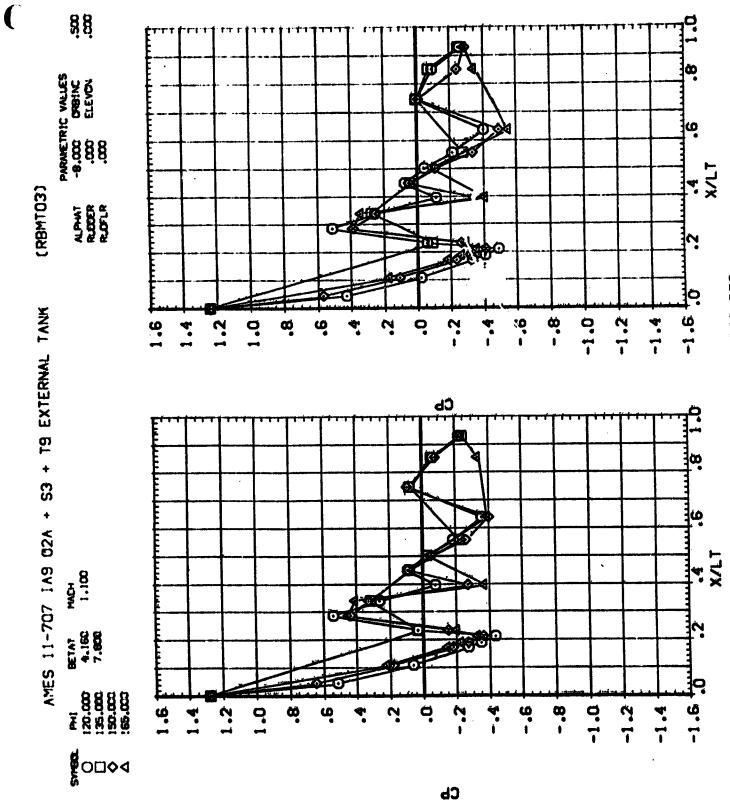
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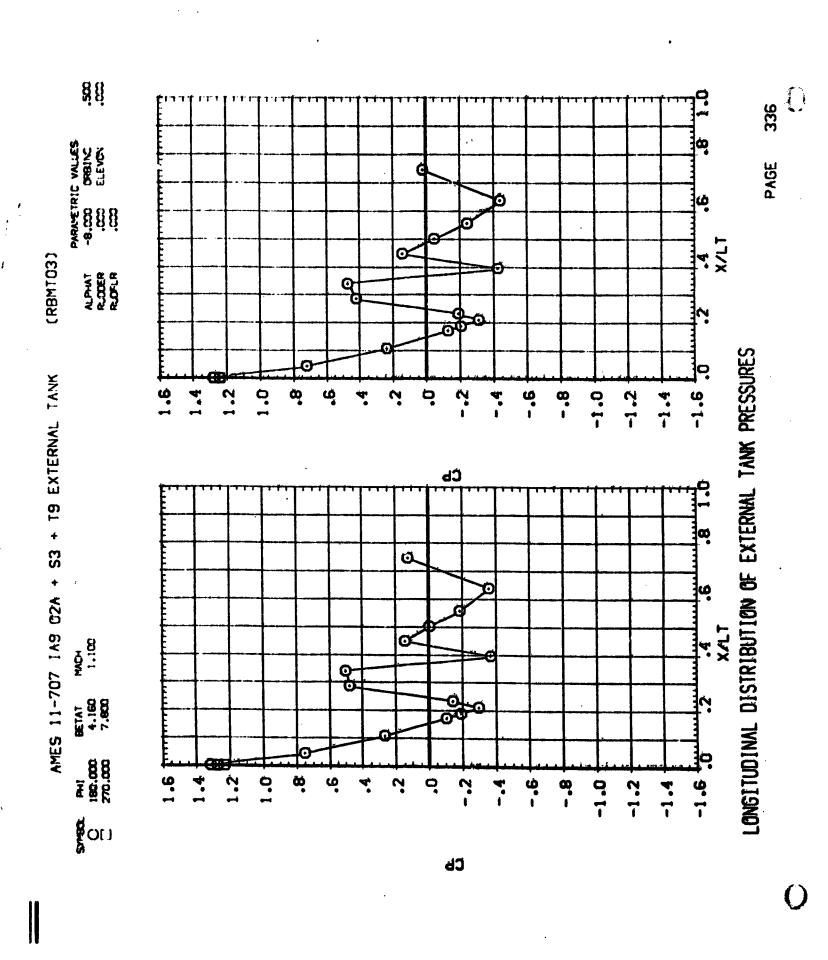
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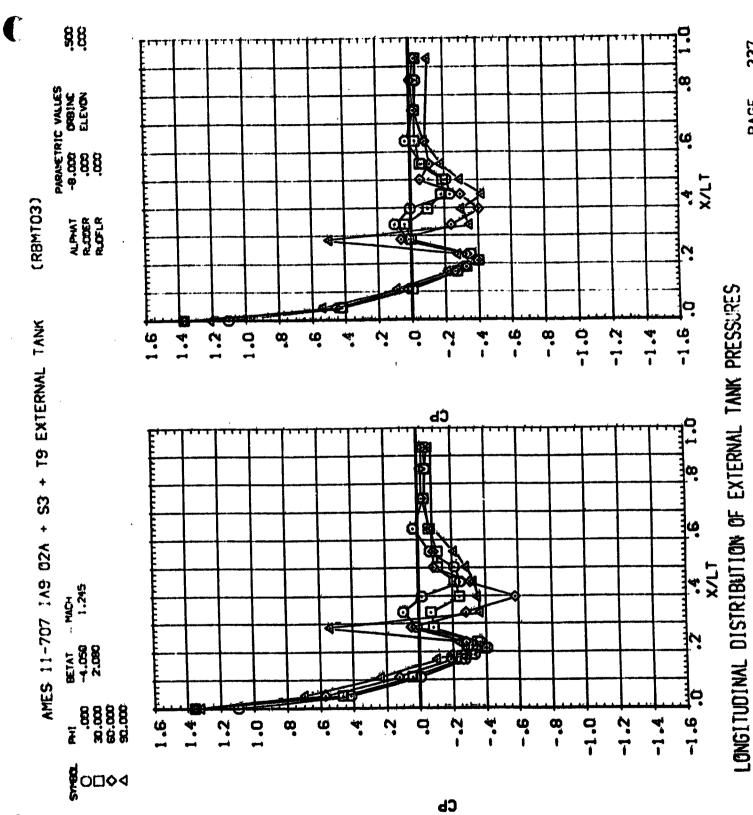




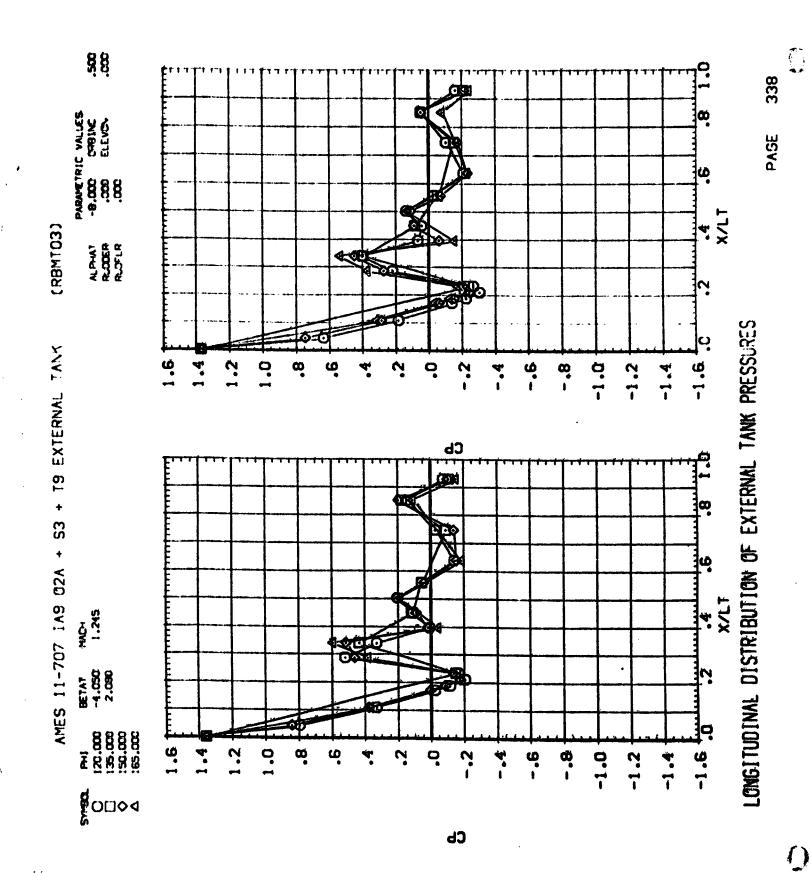
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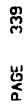


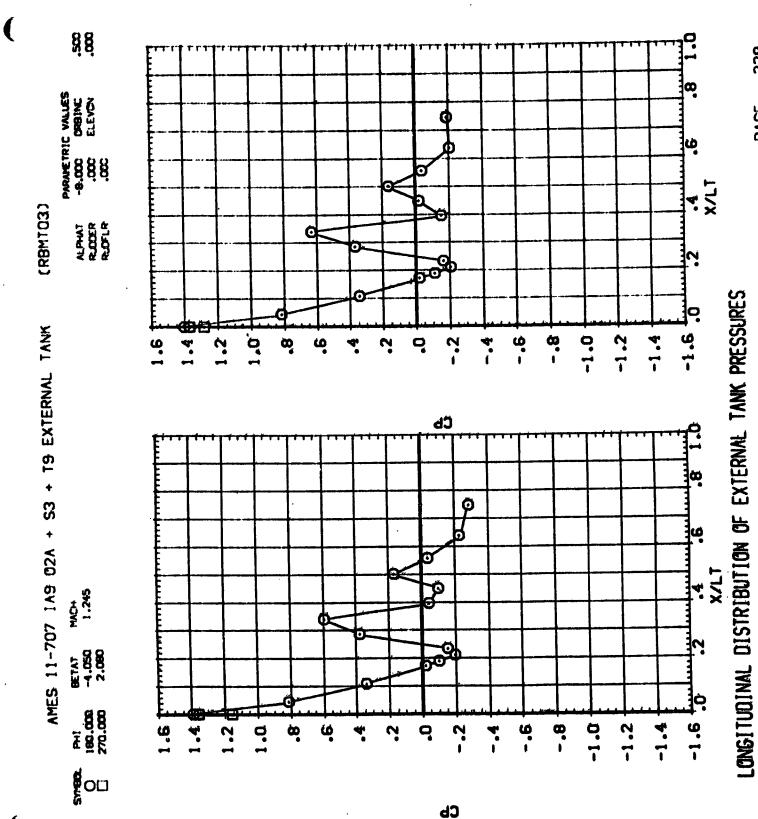
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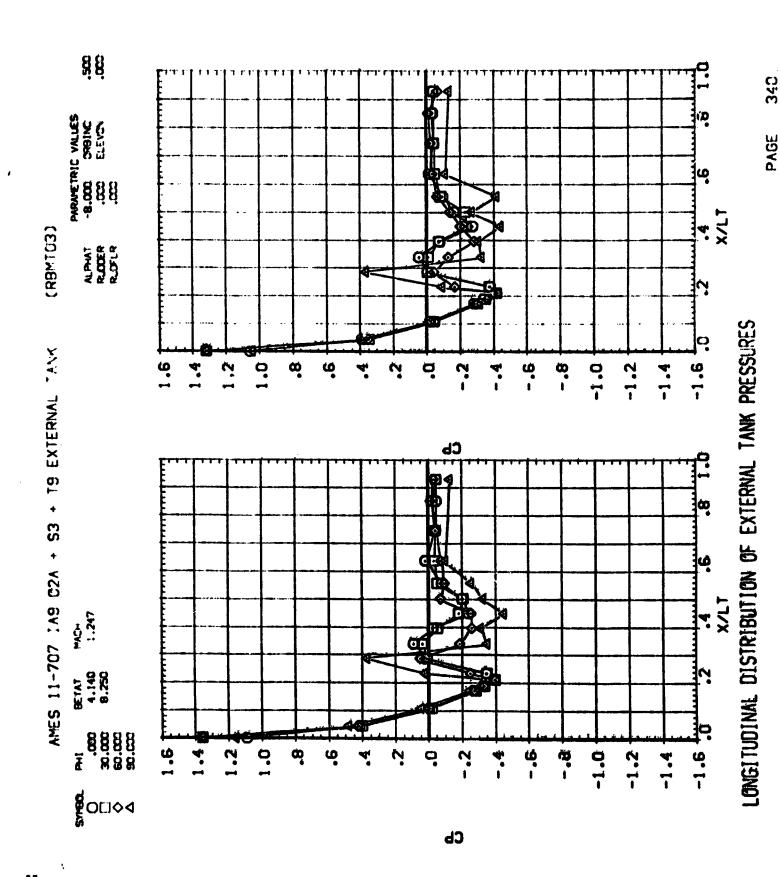
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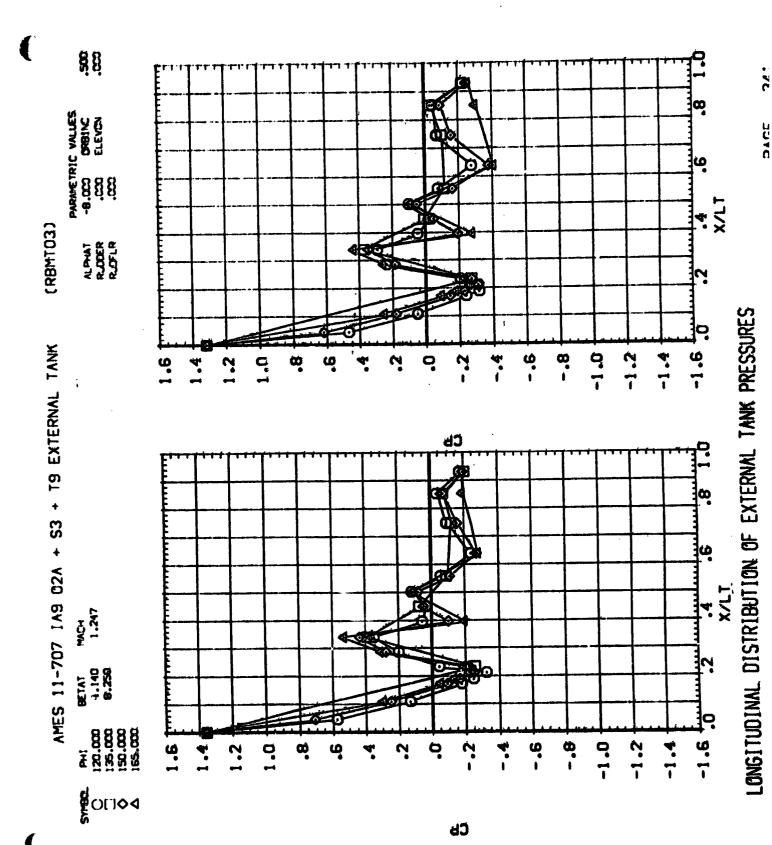




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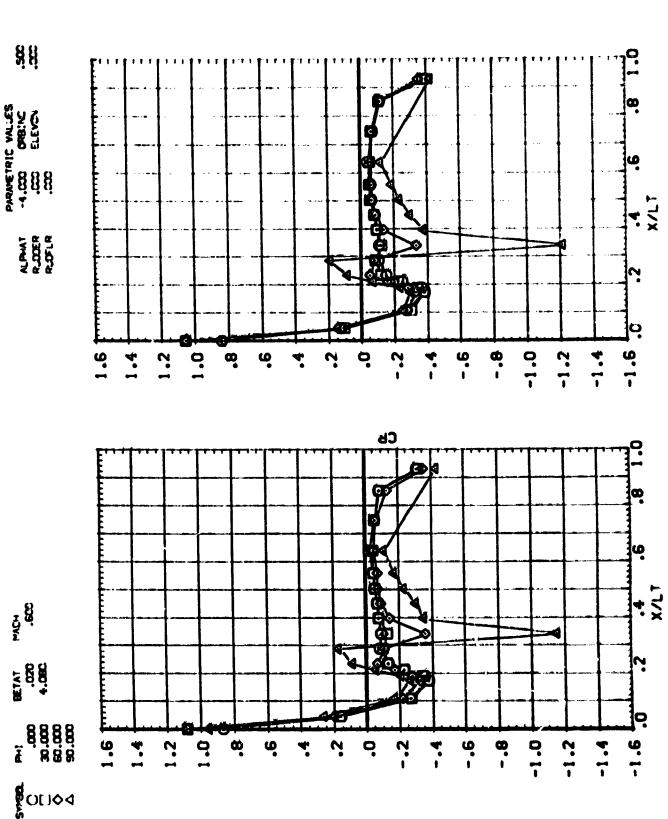


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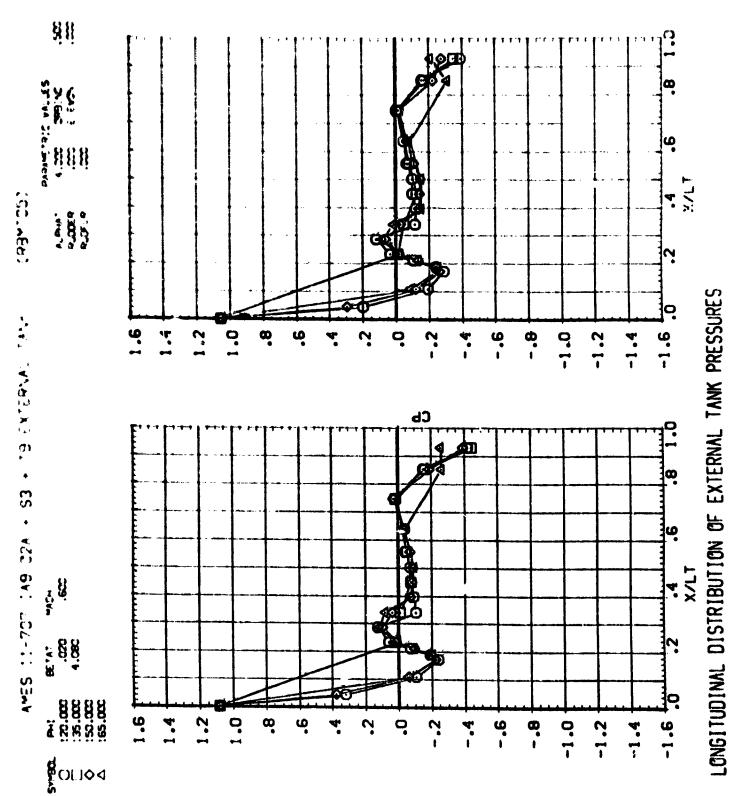
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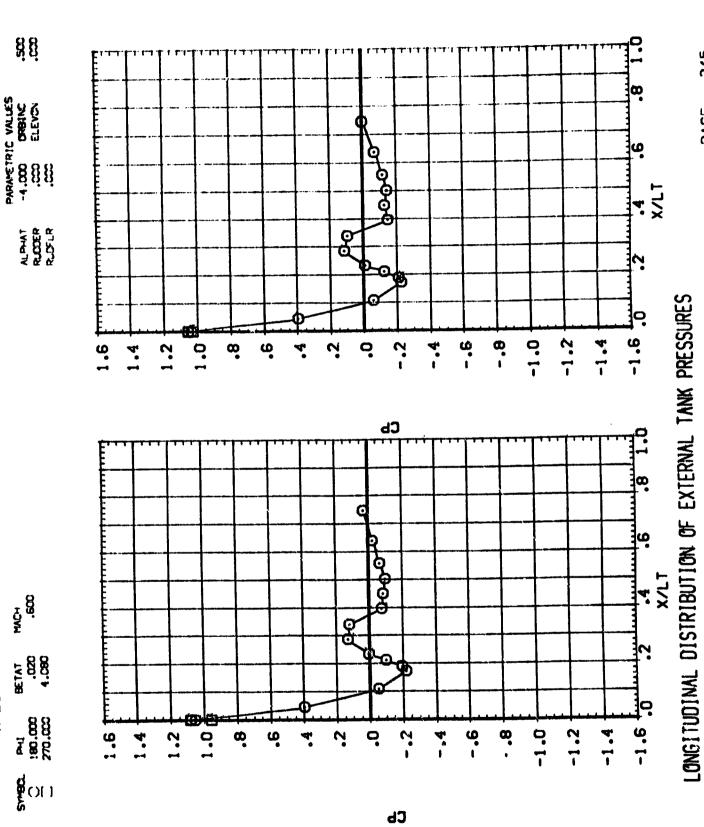
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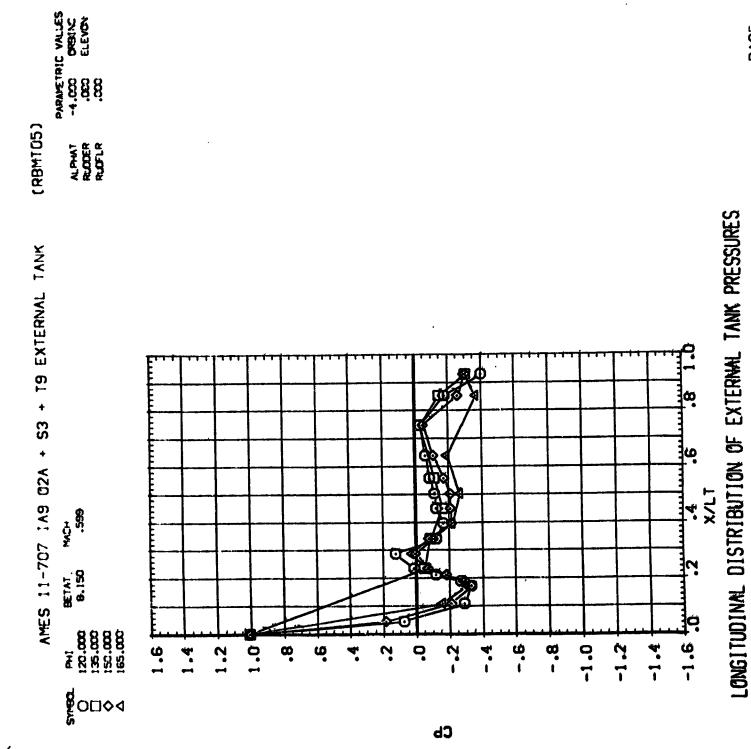
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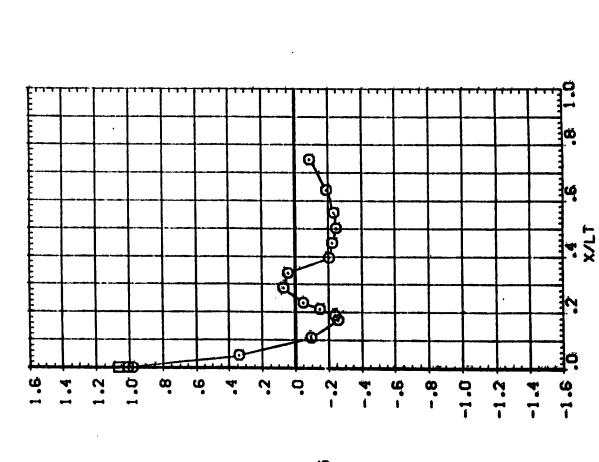
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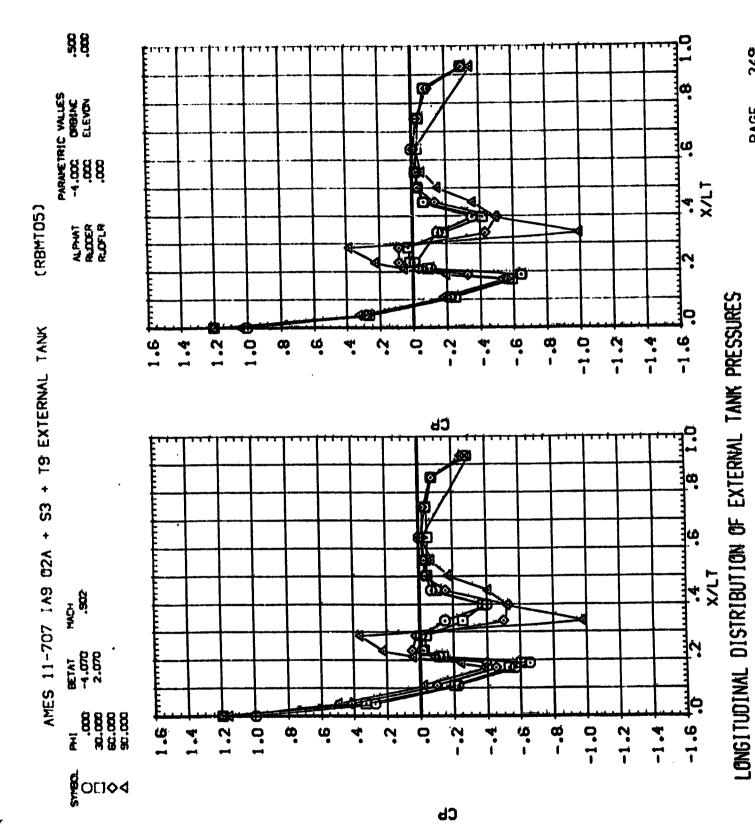
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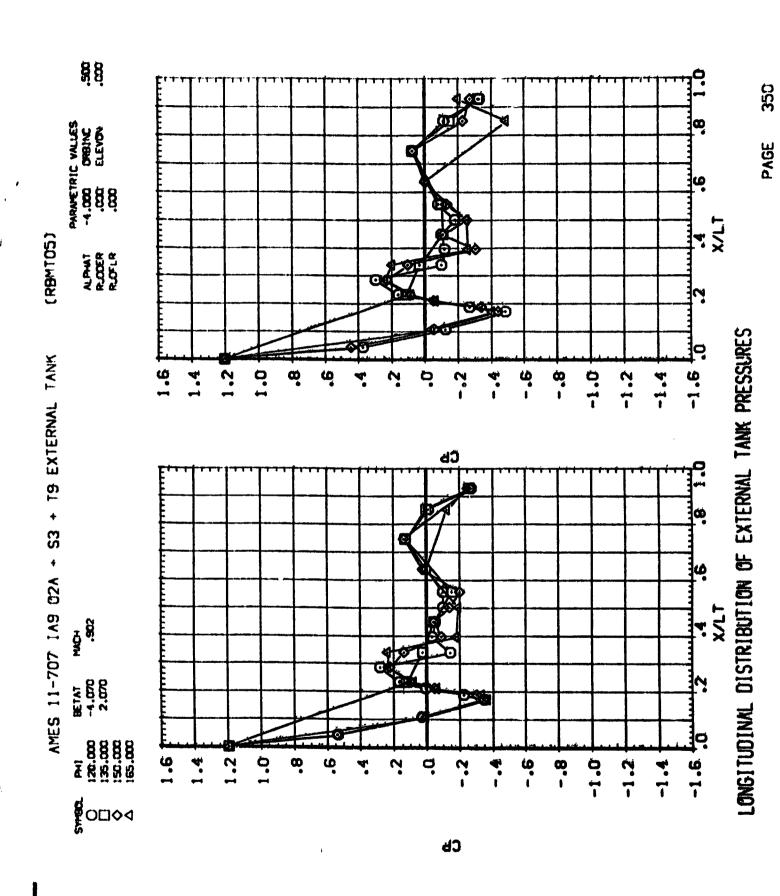


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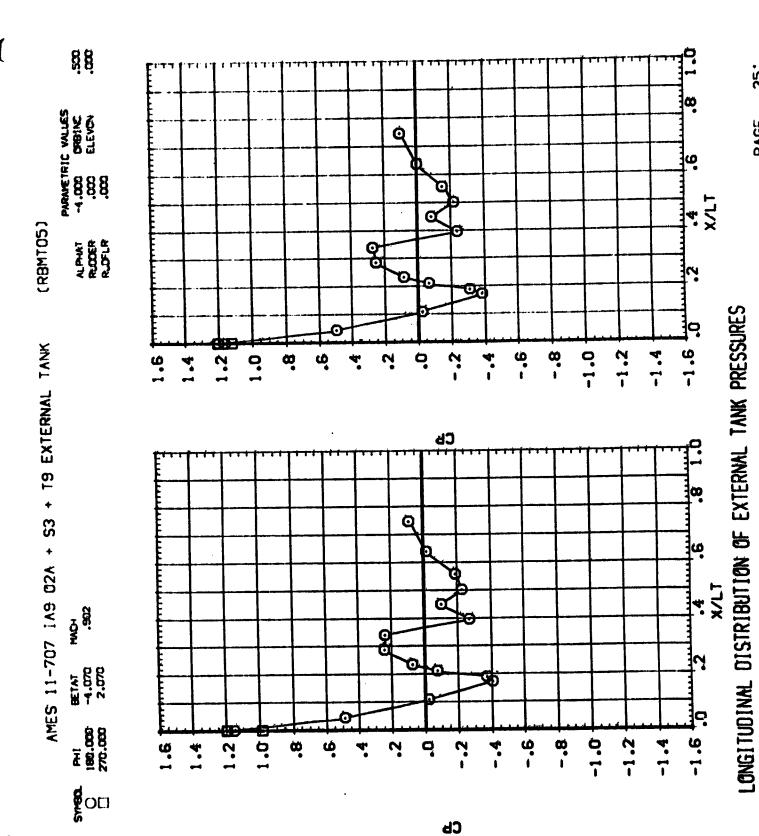


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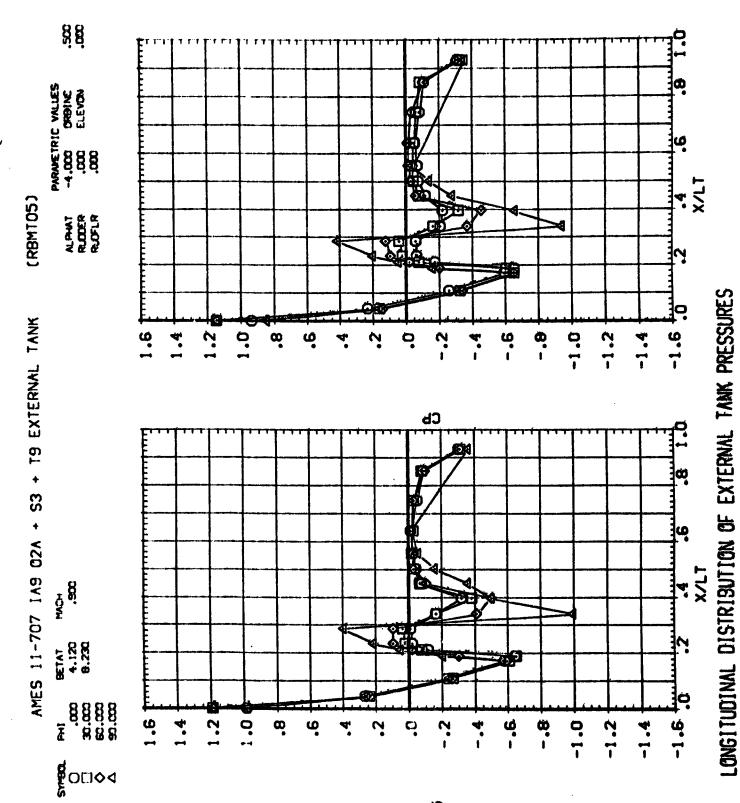
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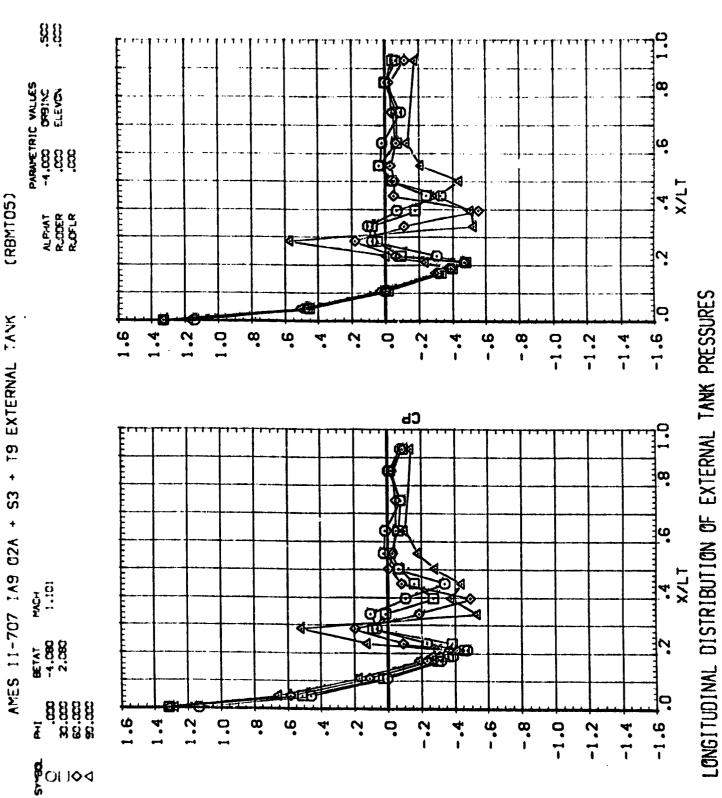


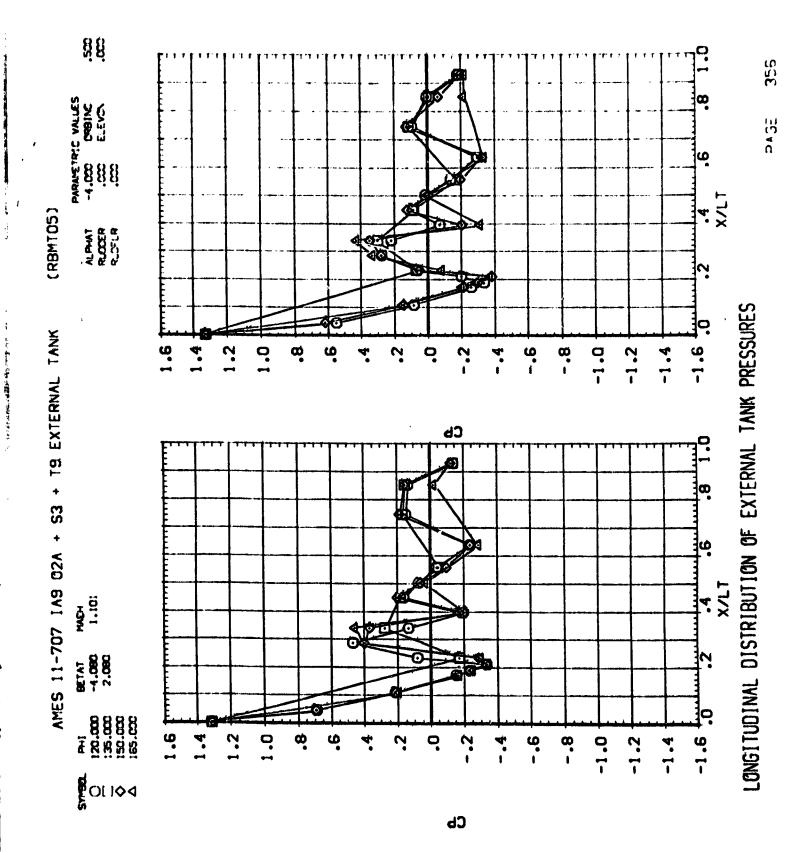
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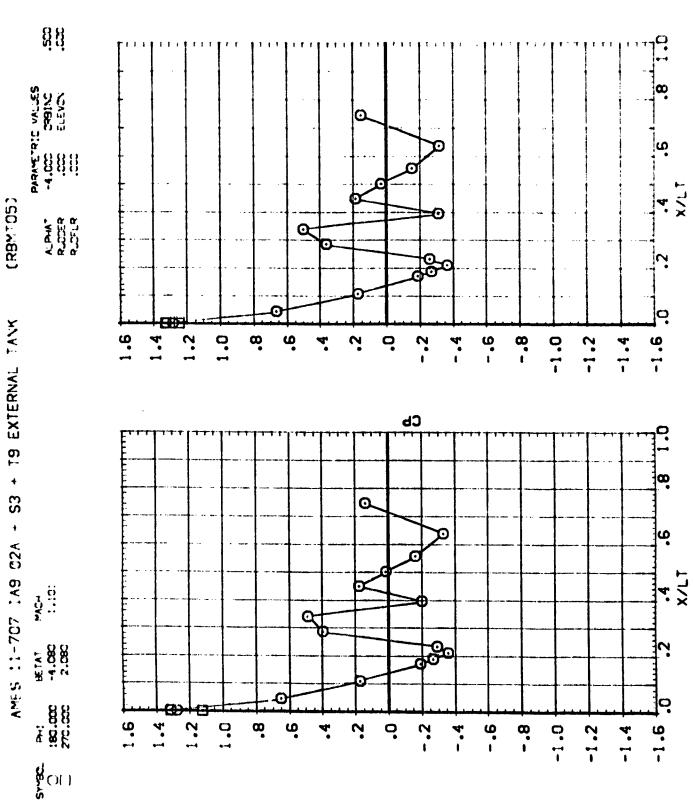
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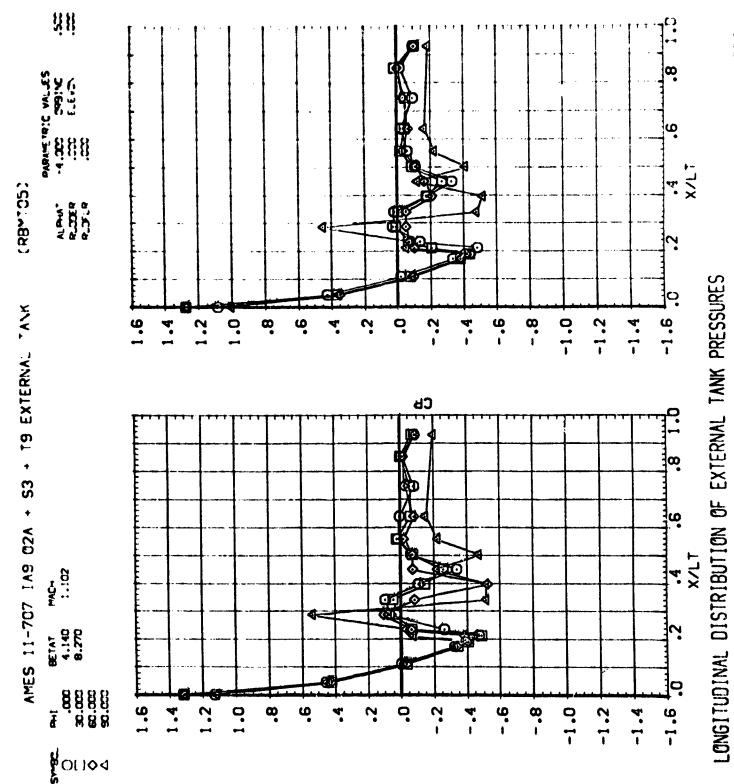




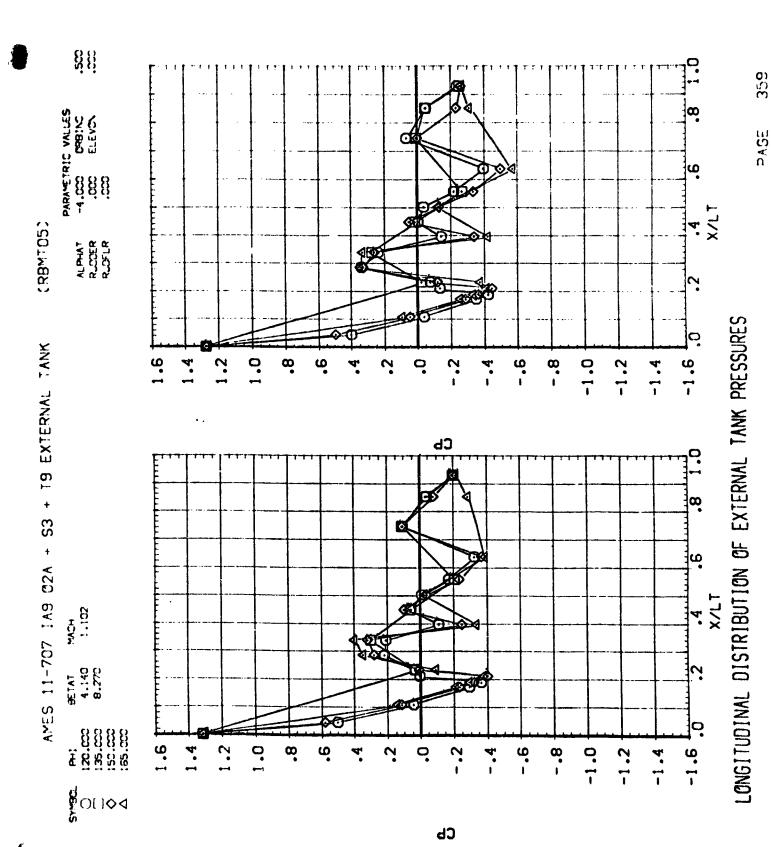
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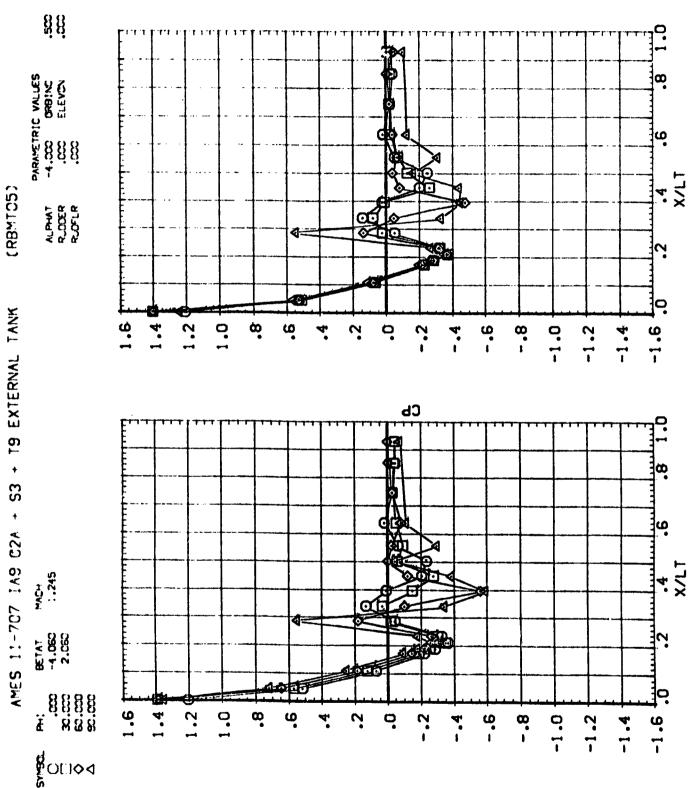
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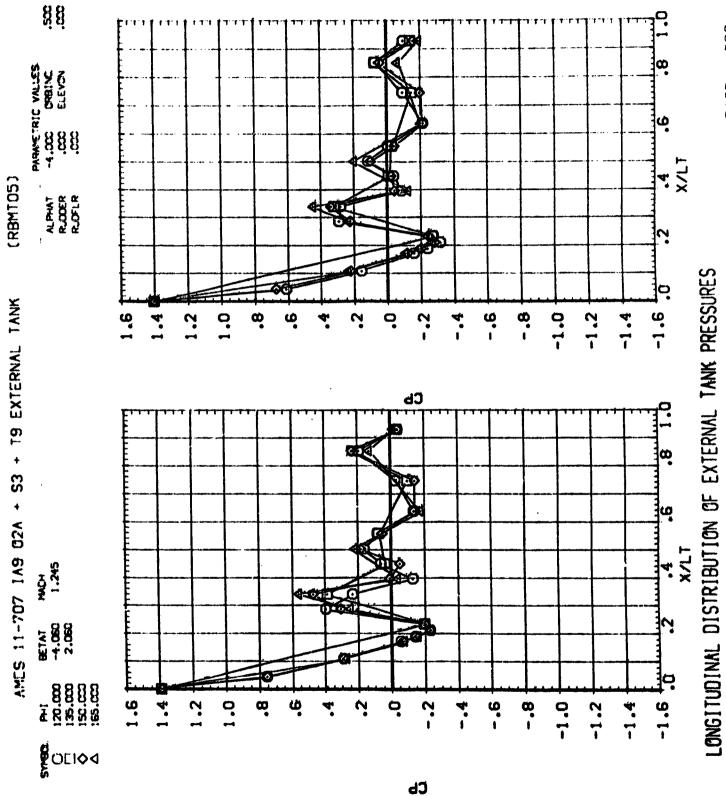


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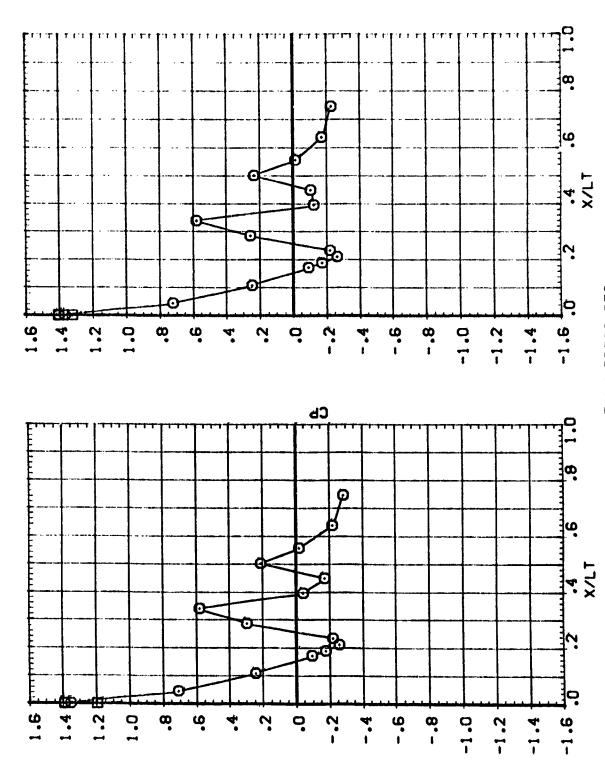
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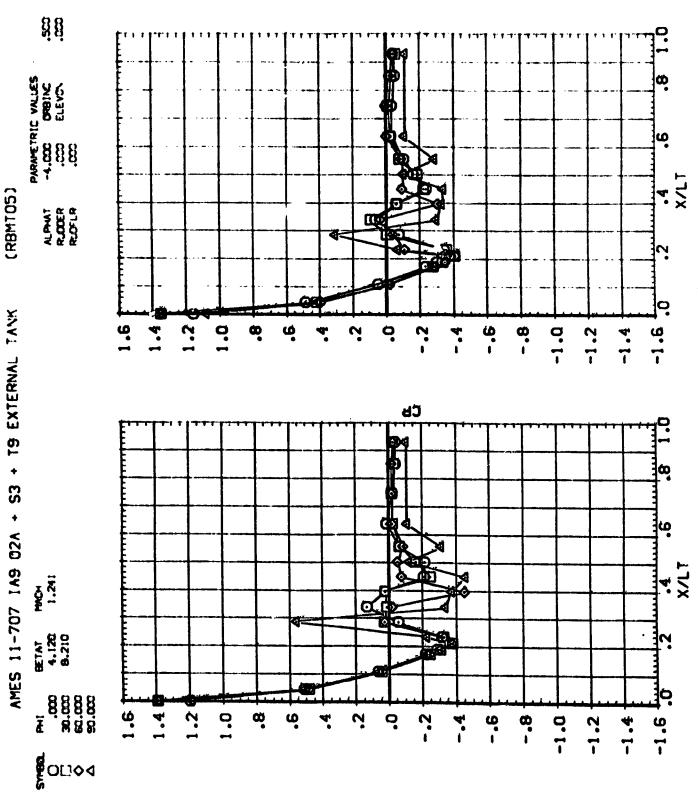
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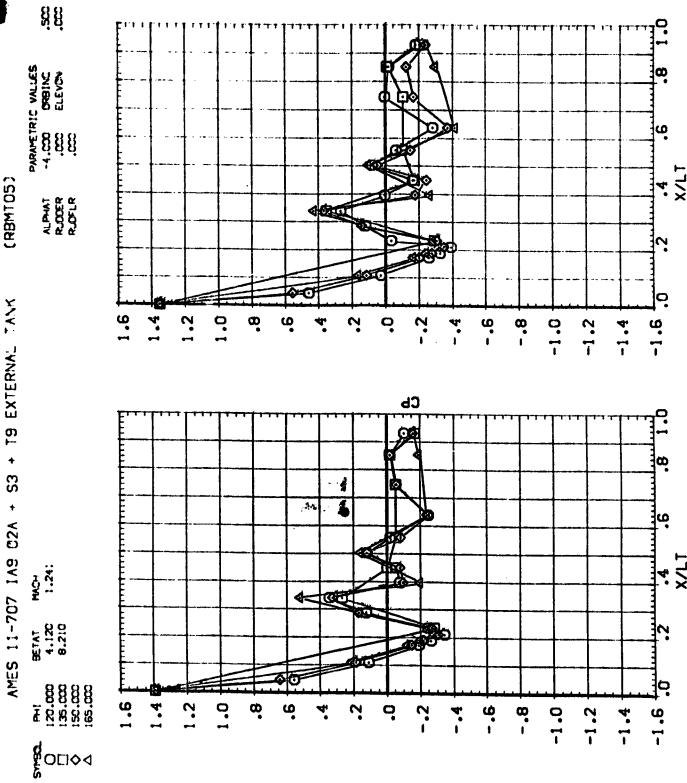
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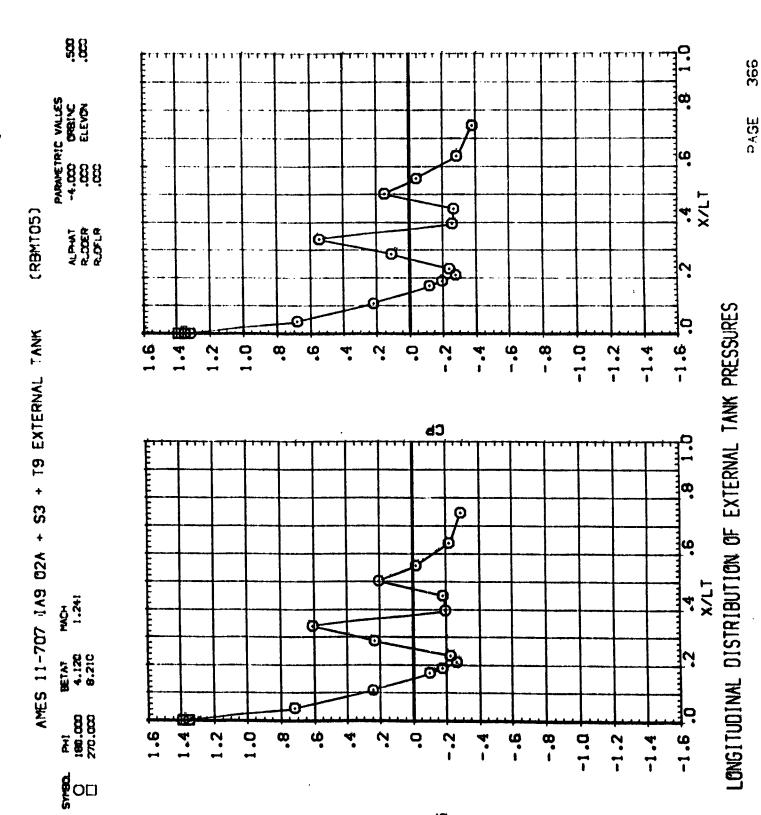
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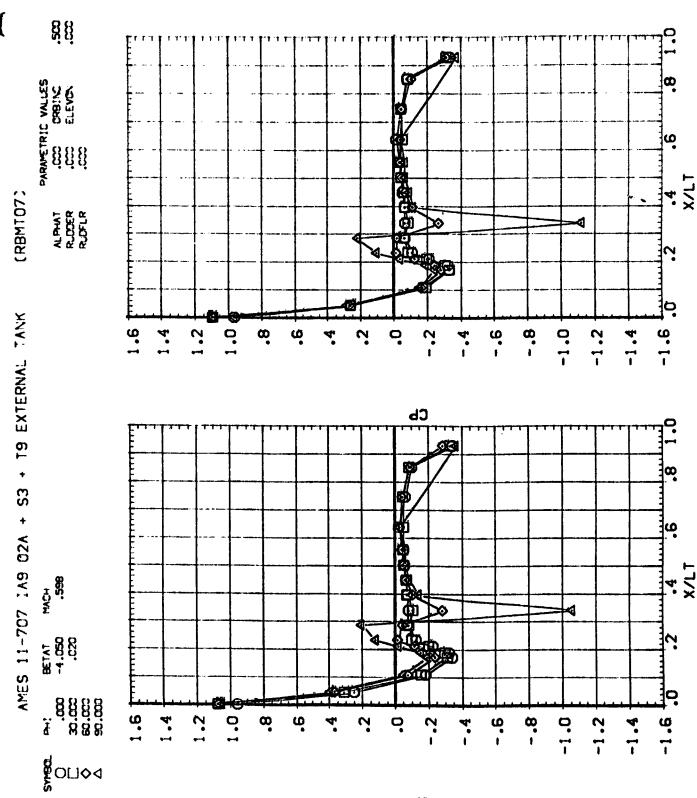


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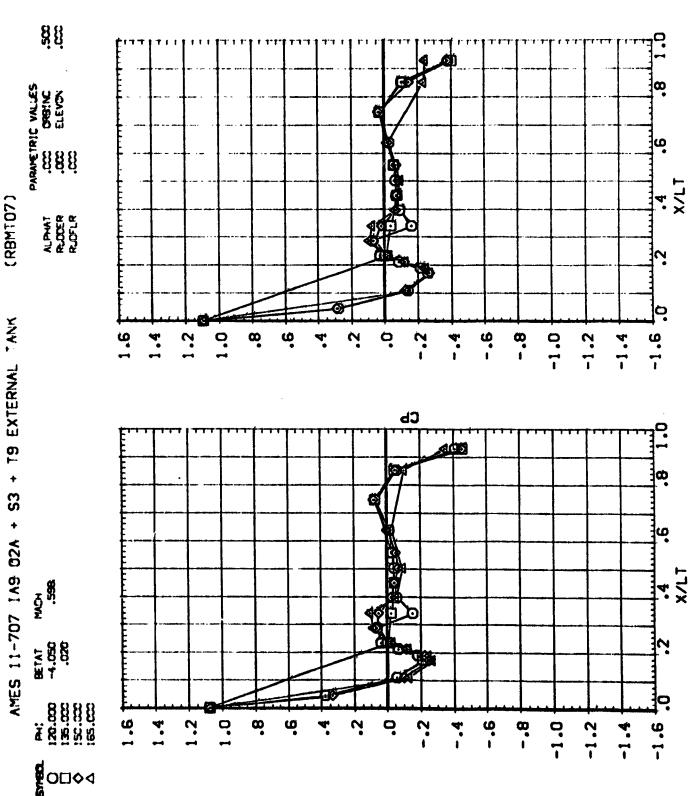
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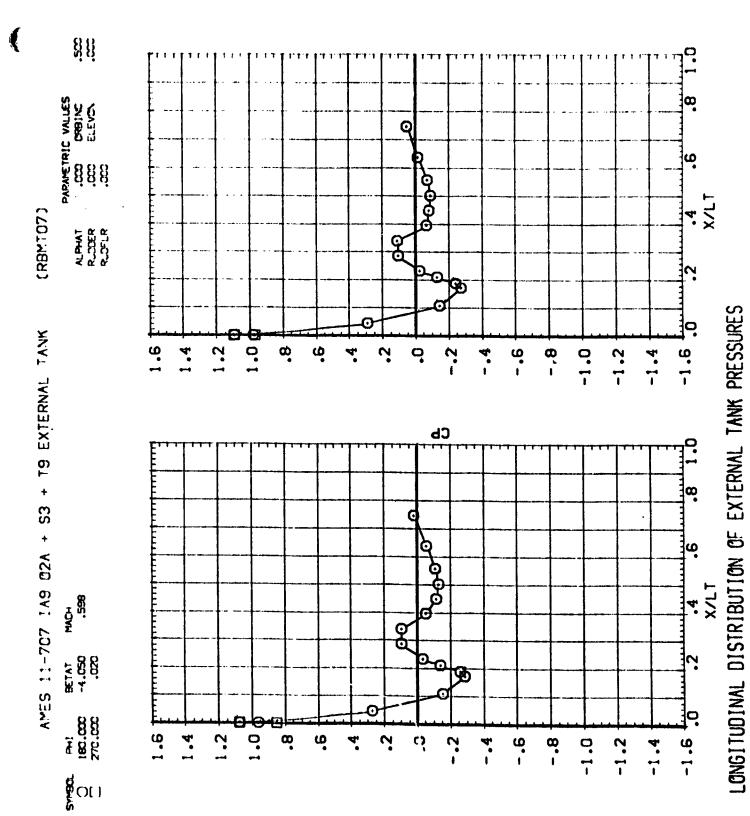


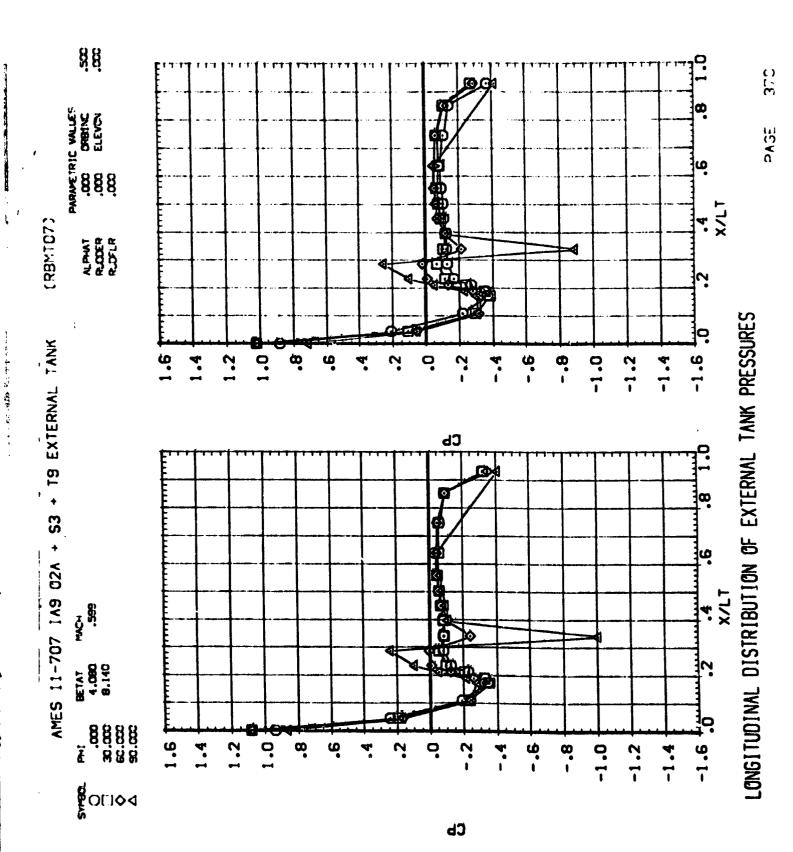
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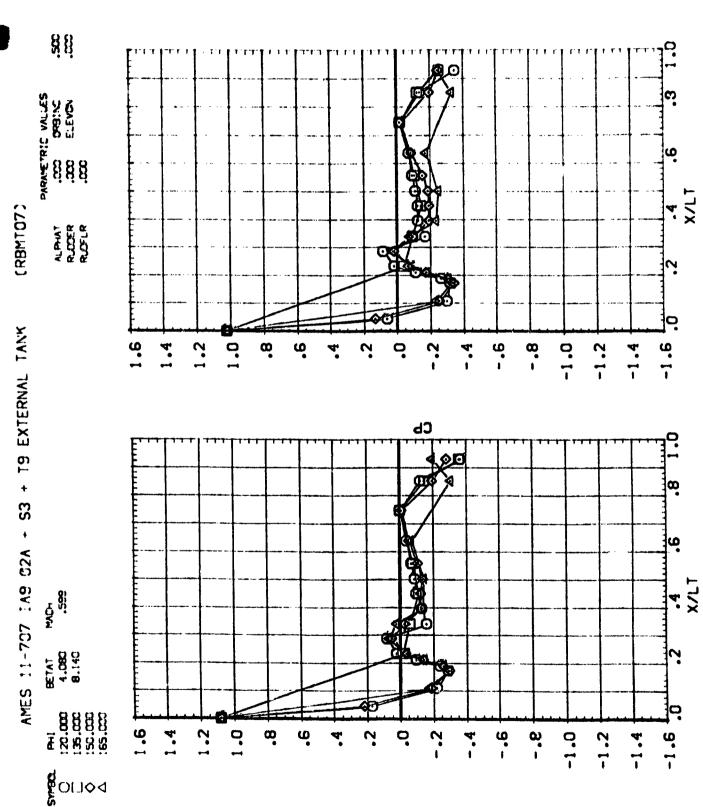
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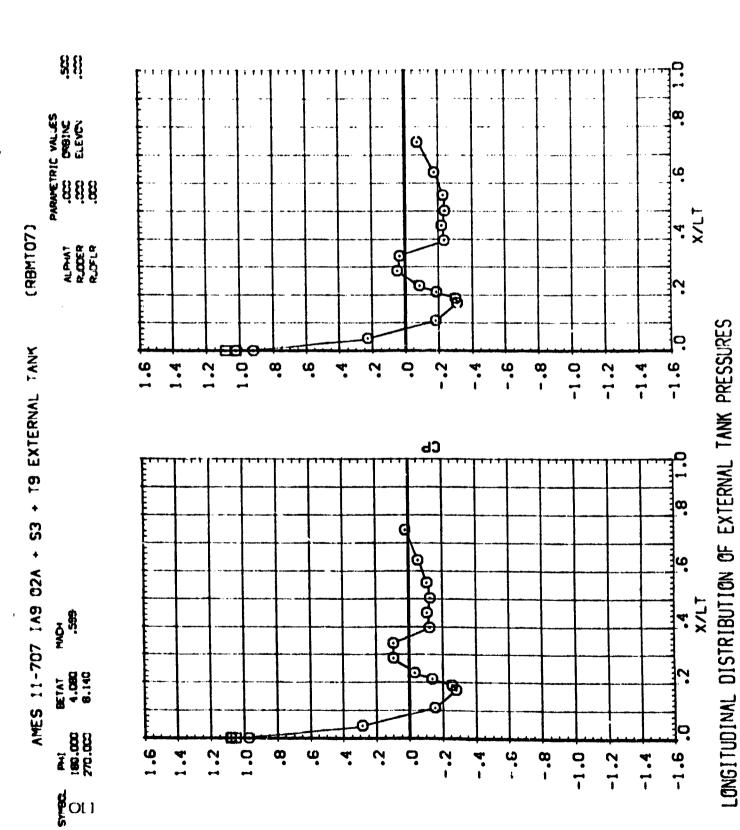




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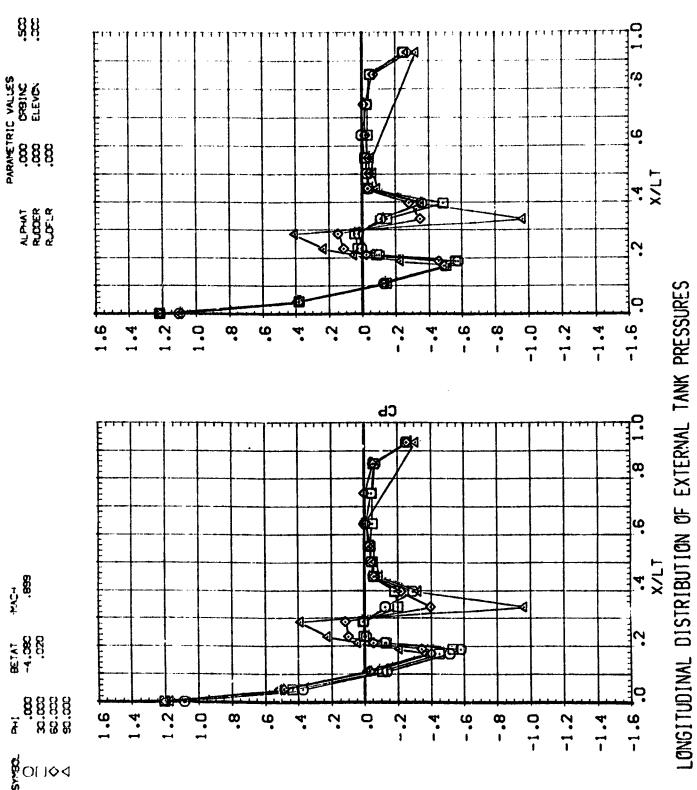
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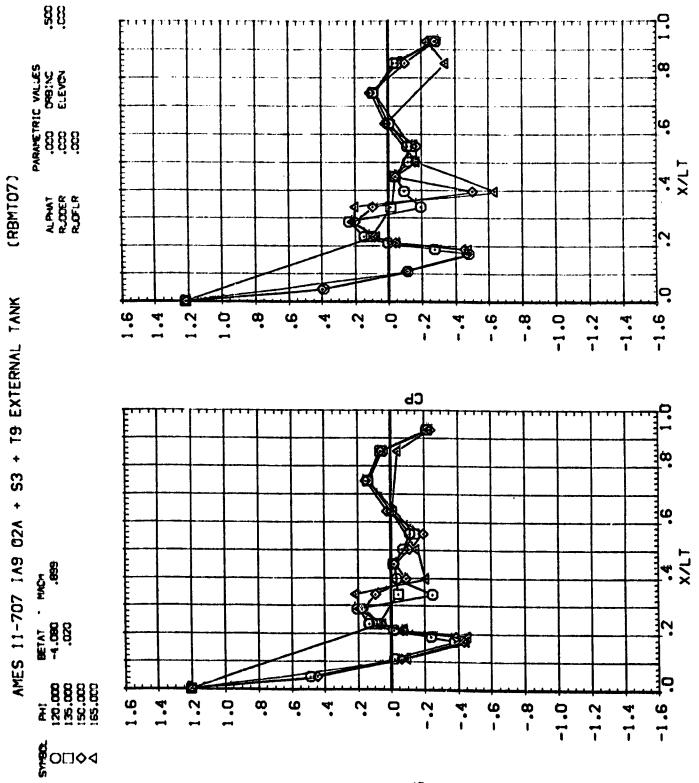
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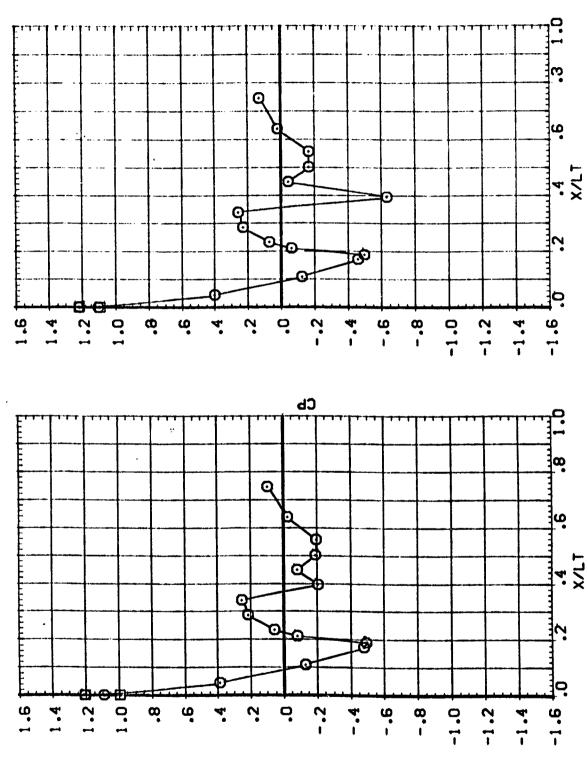
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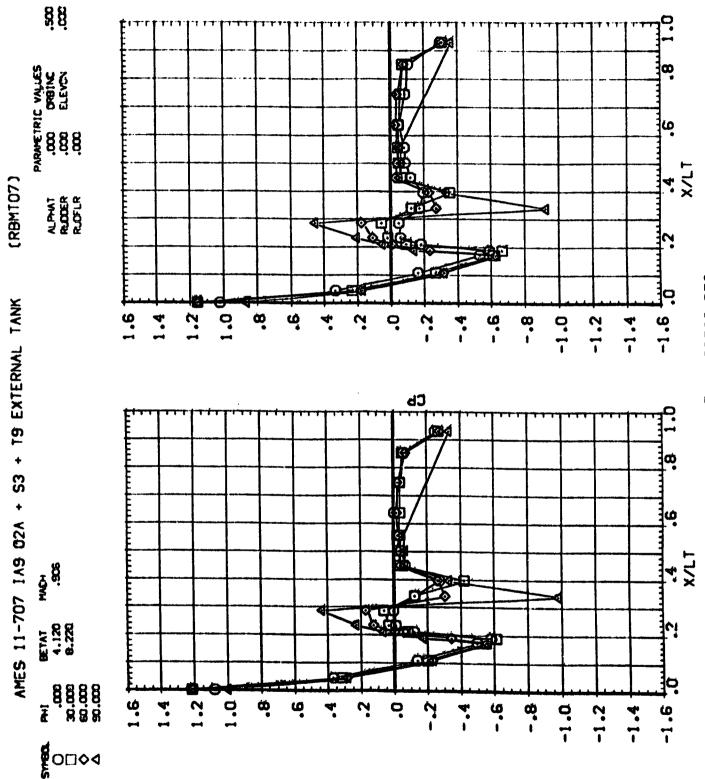
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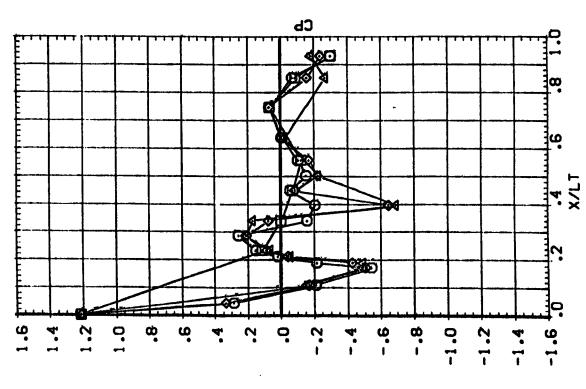
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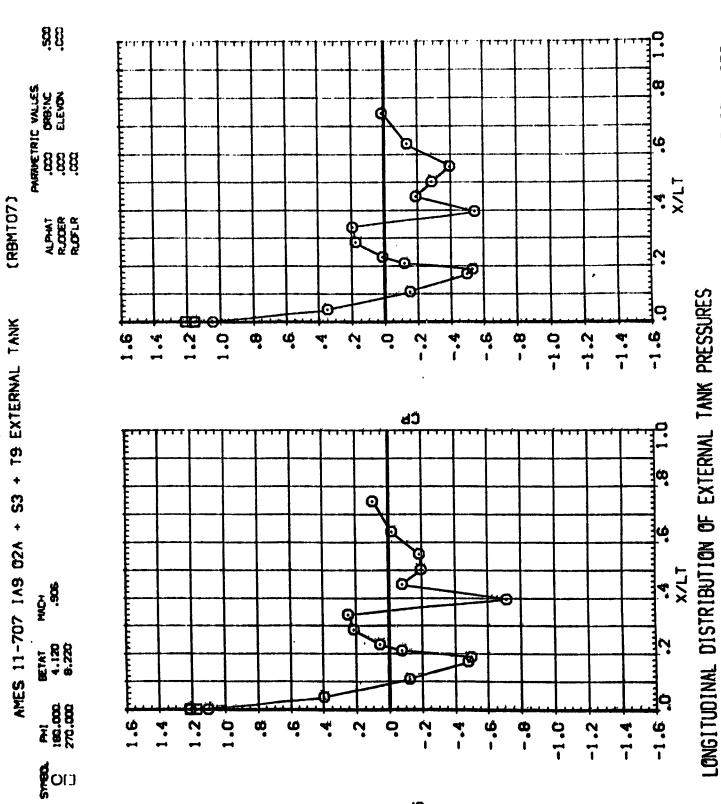
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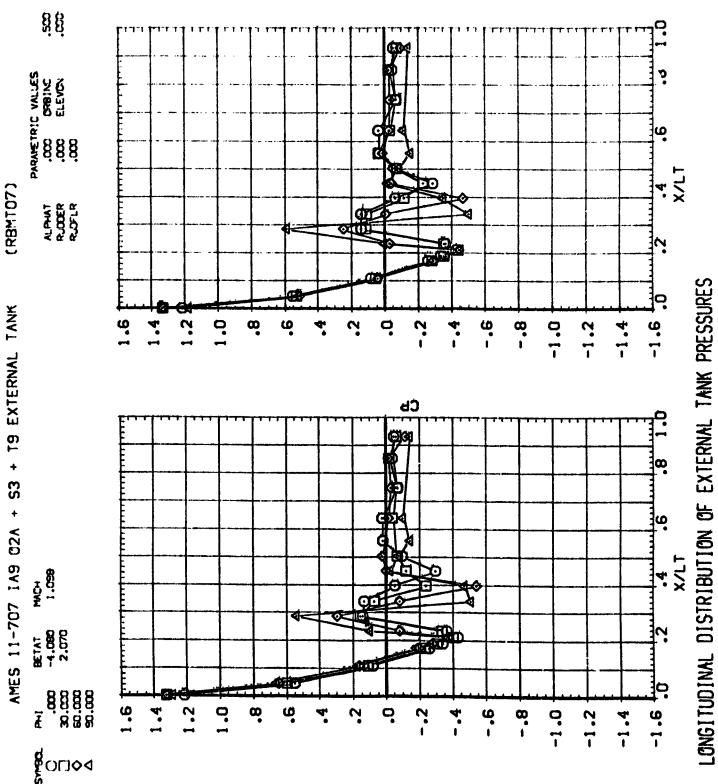
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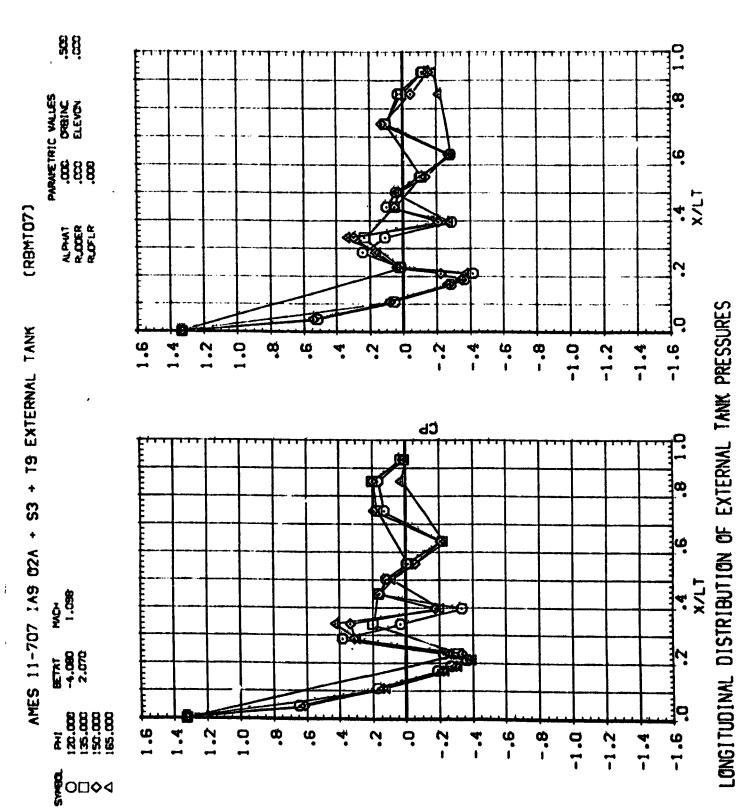
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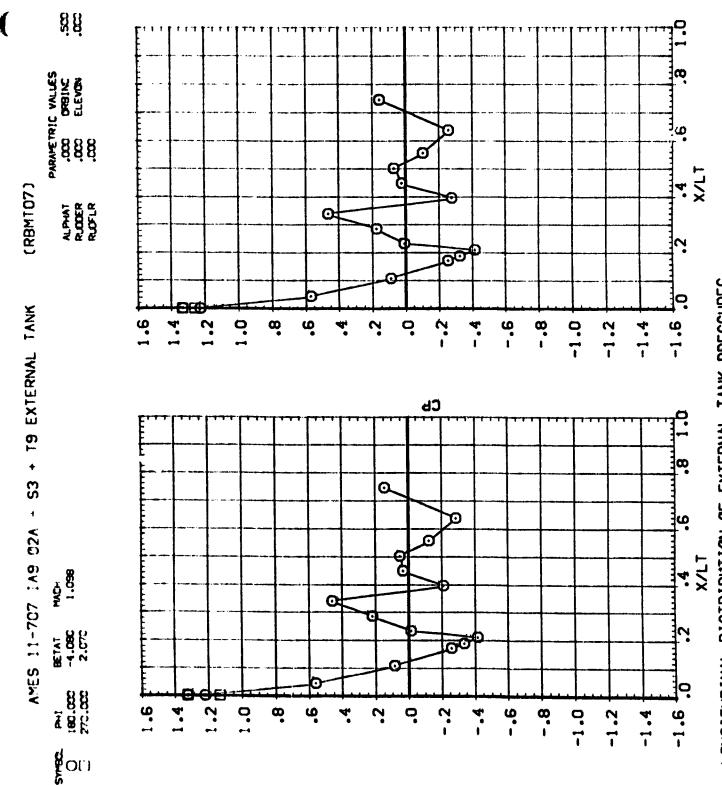


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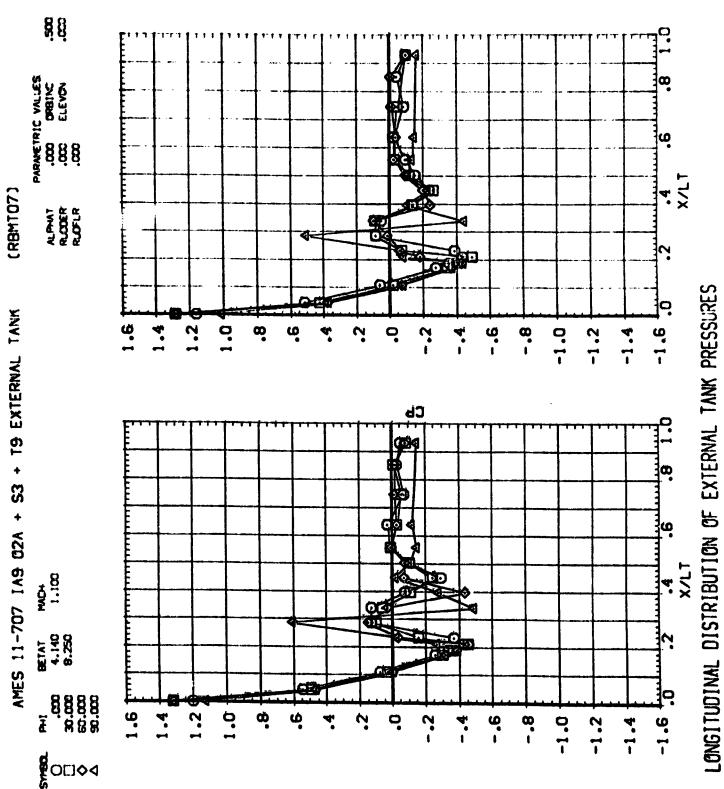
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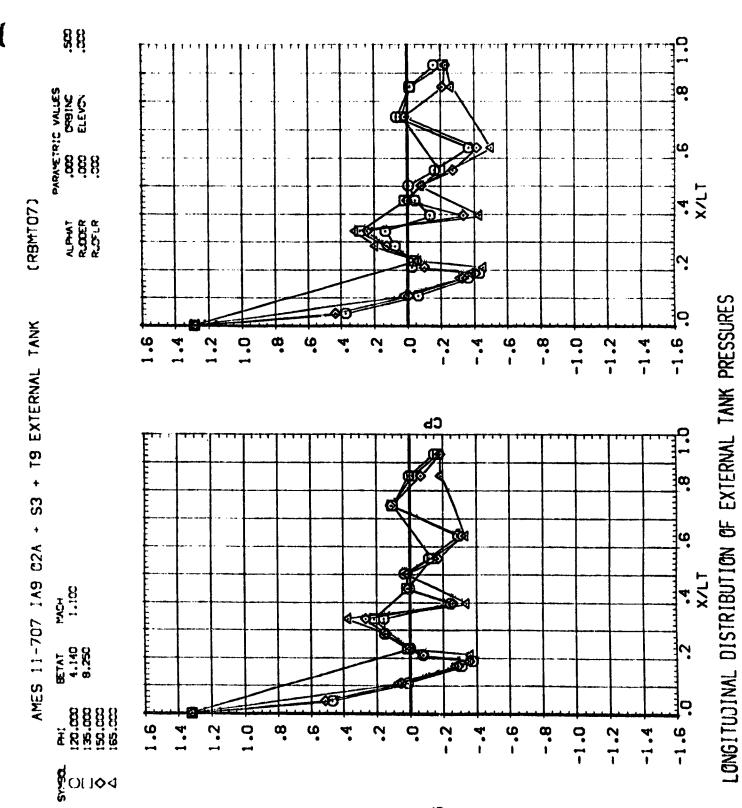
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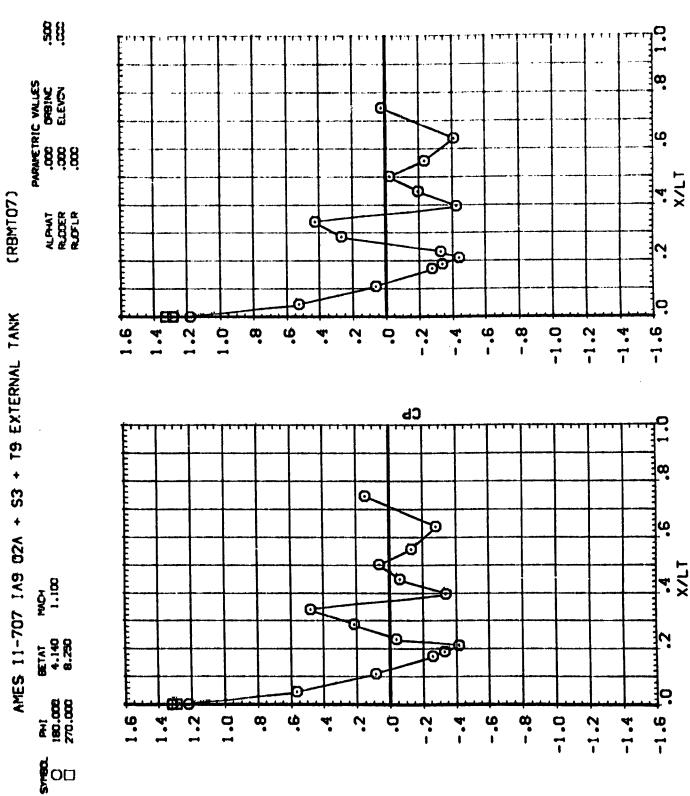
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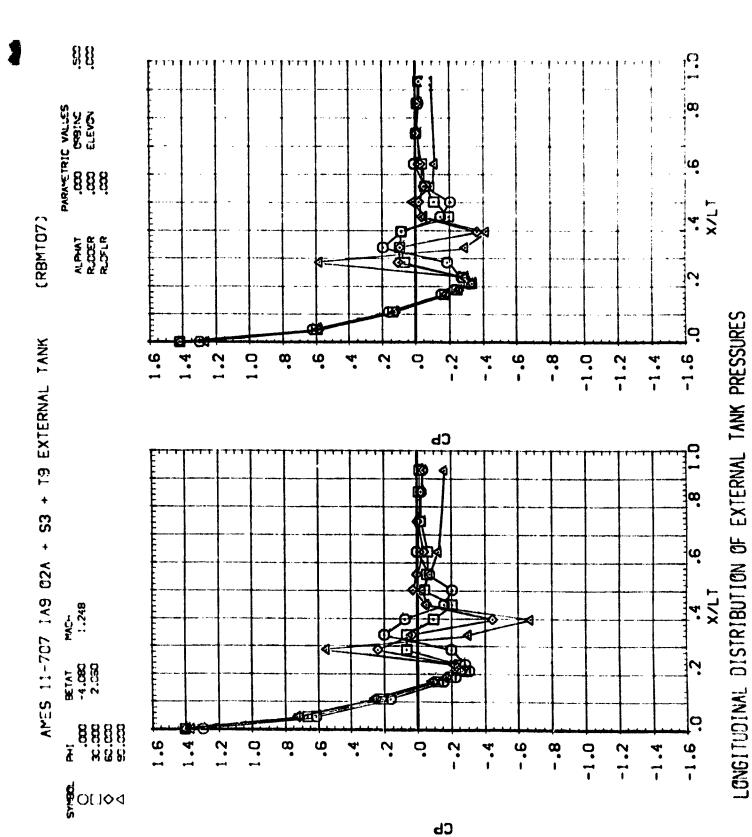
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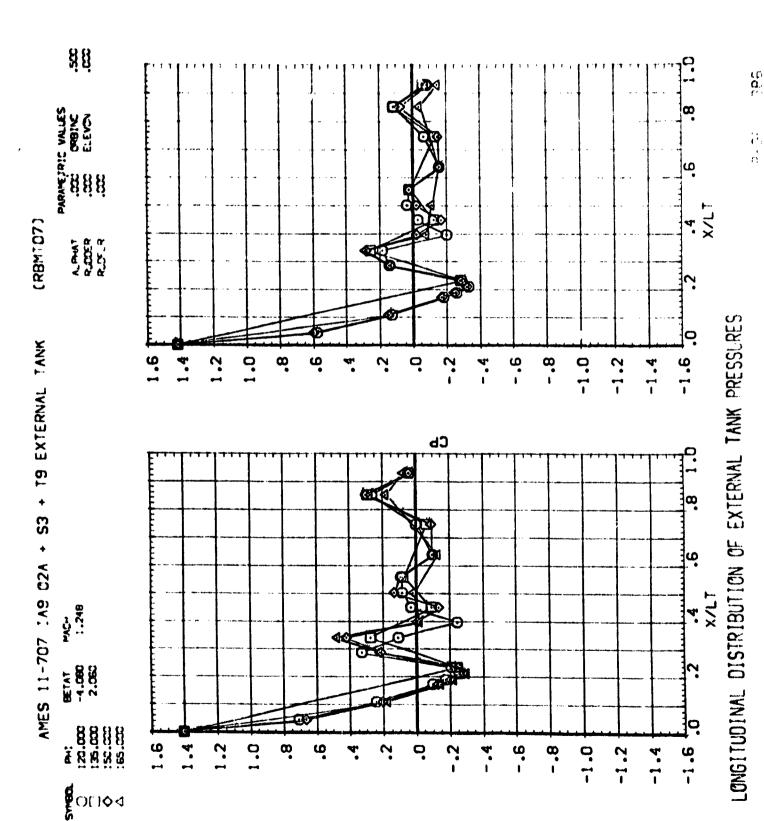


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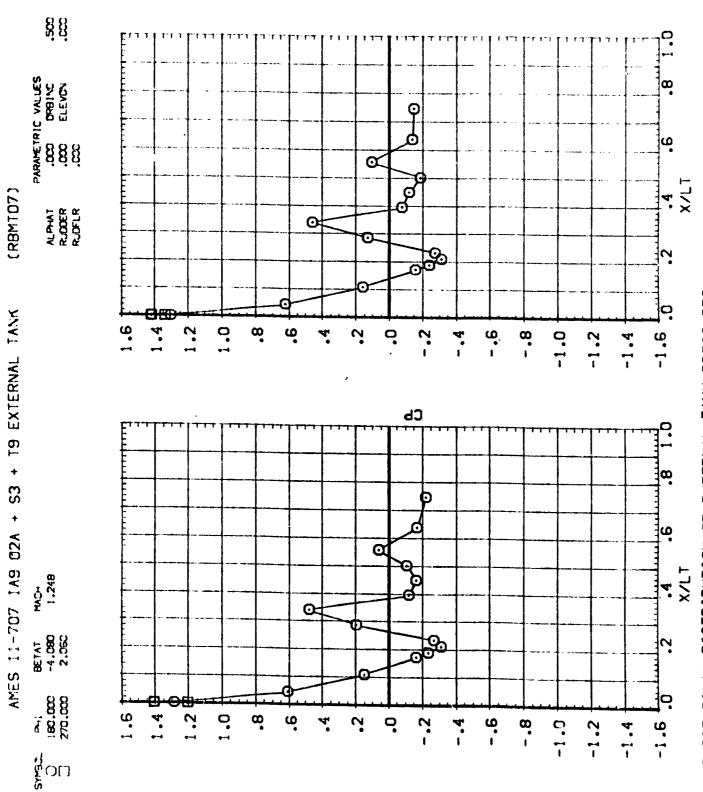
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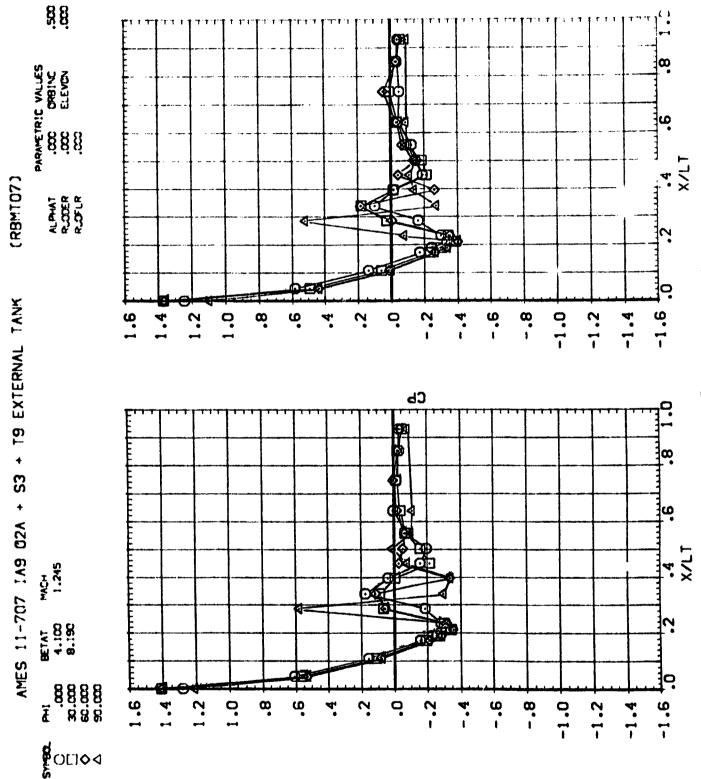
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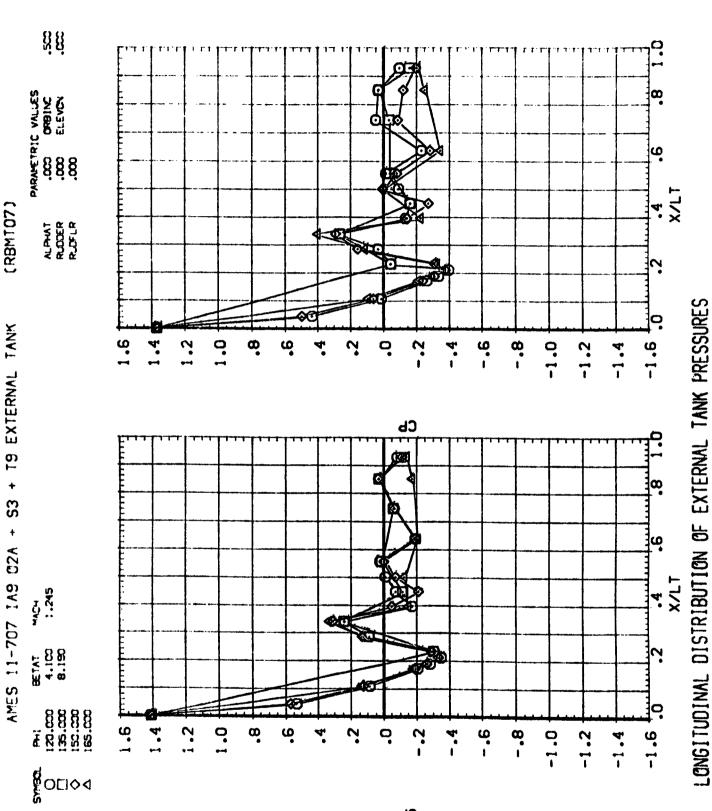
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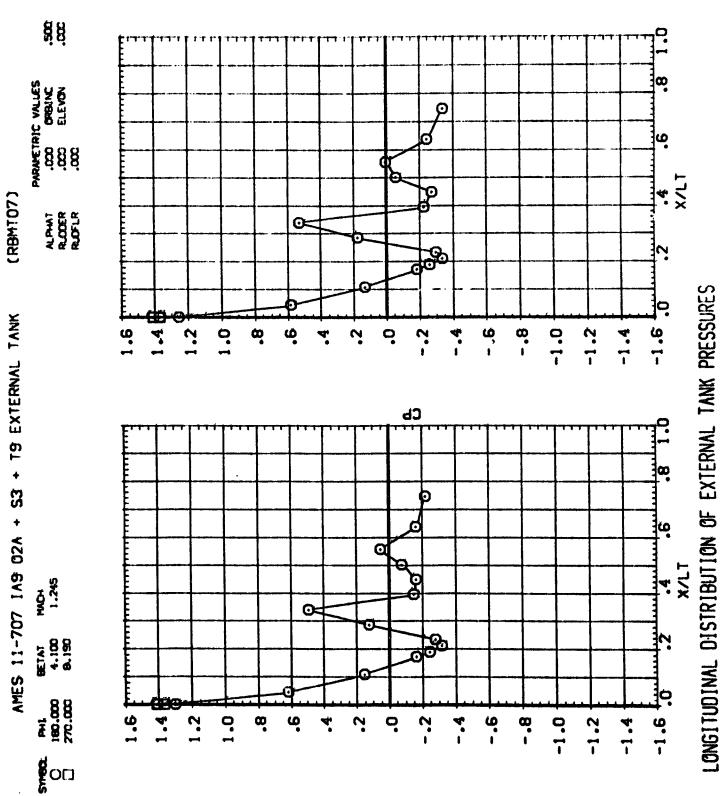
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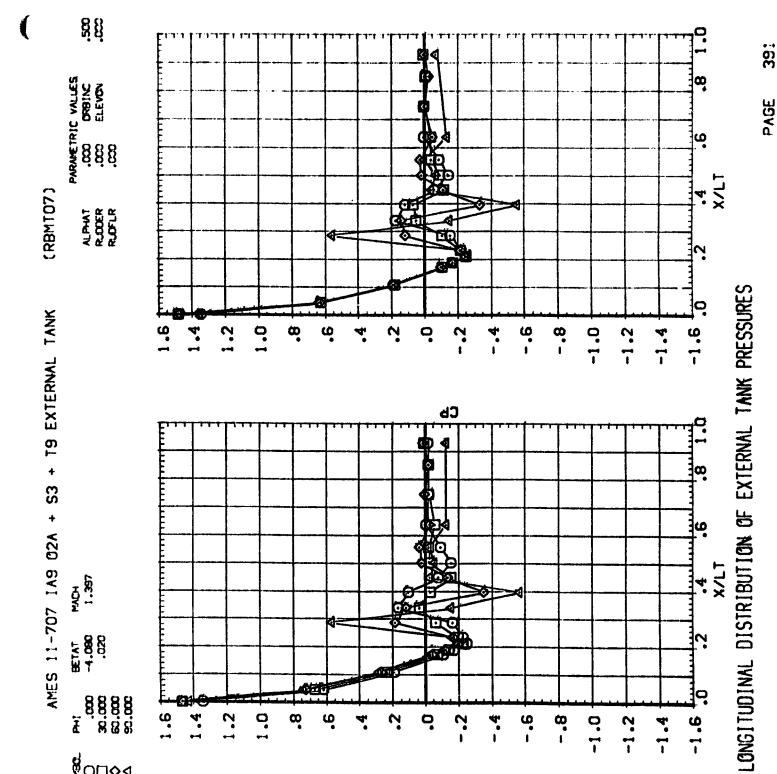
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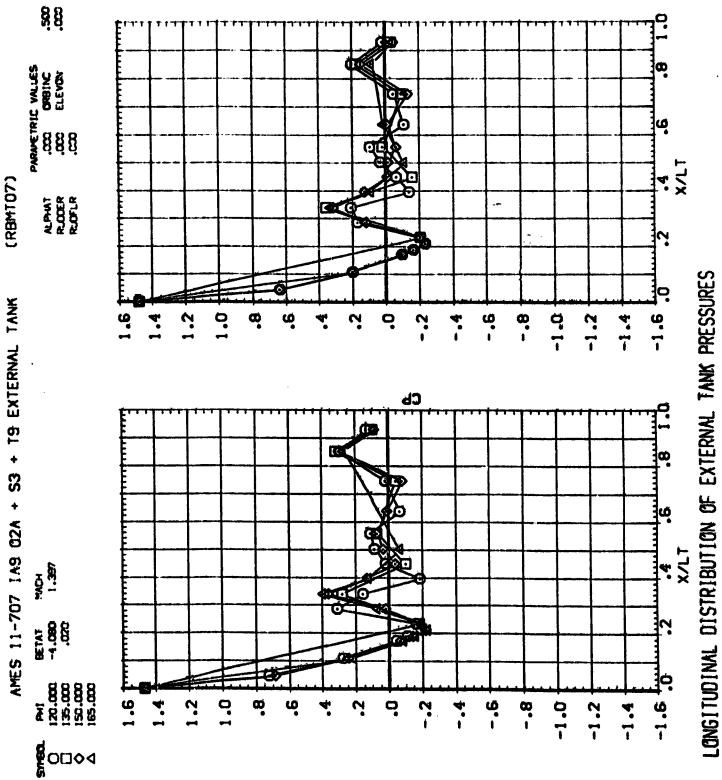
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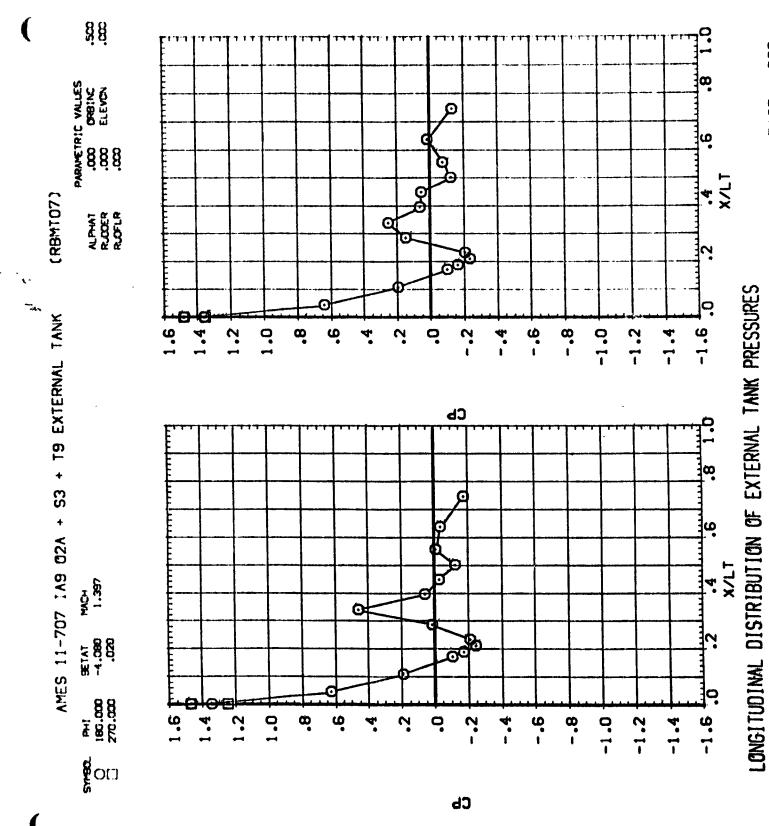
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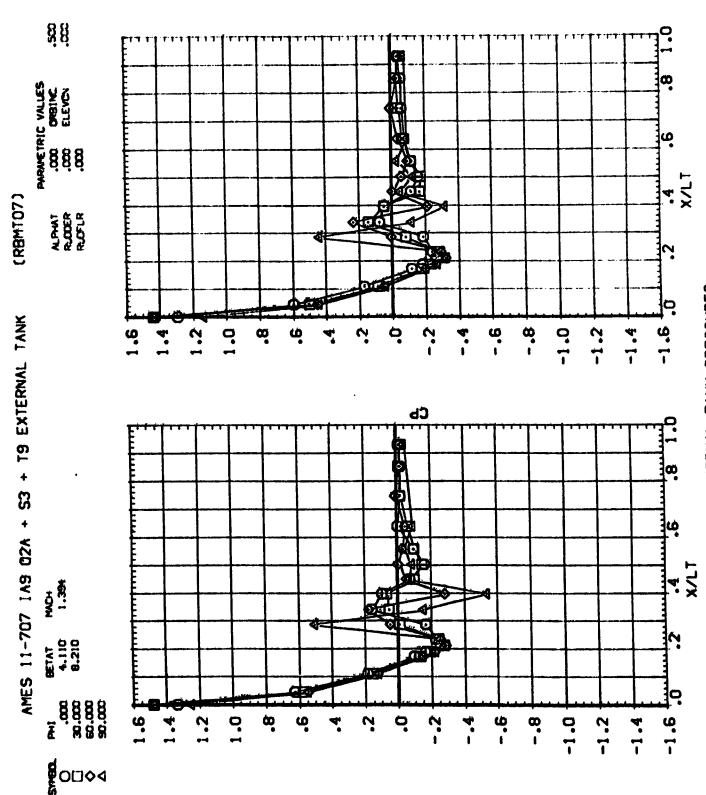


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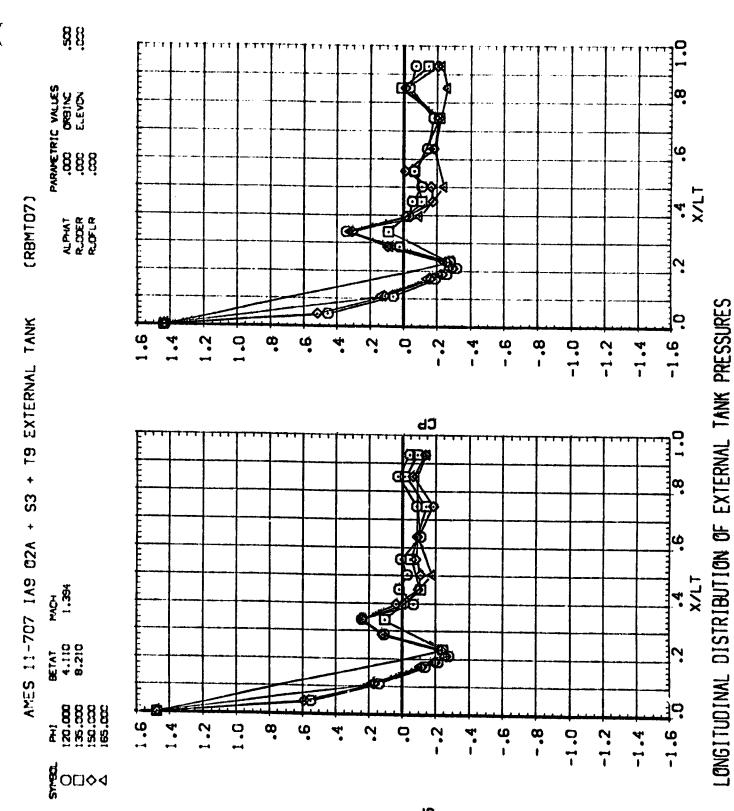


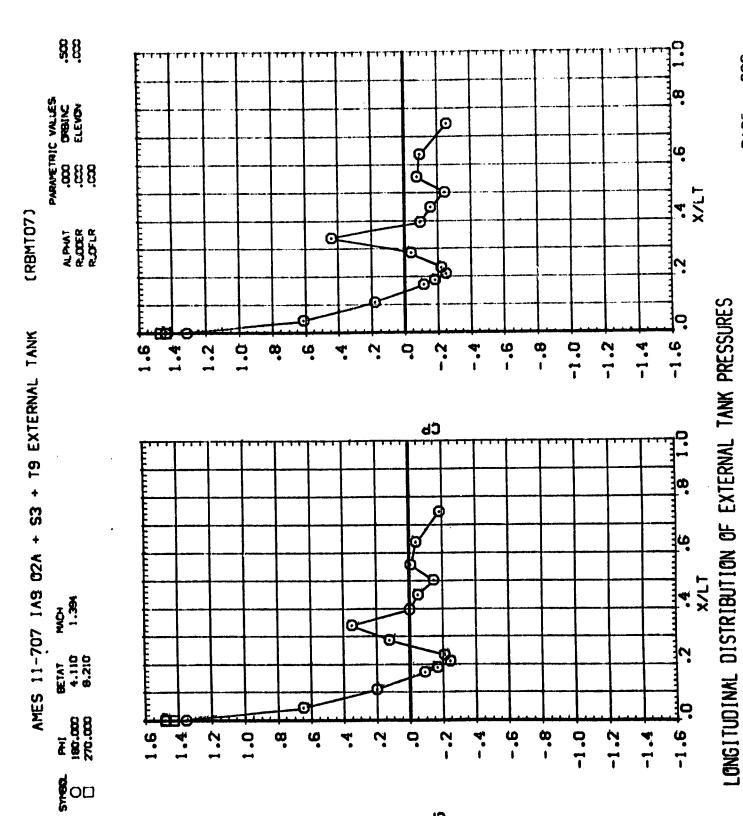


LONGITUDINAL DISTRIBUTION OF EXTERNAL TANK PRESSURES

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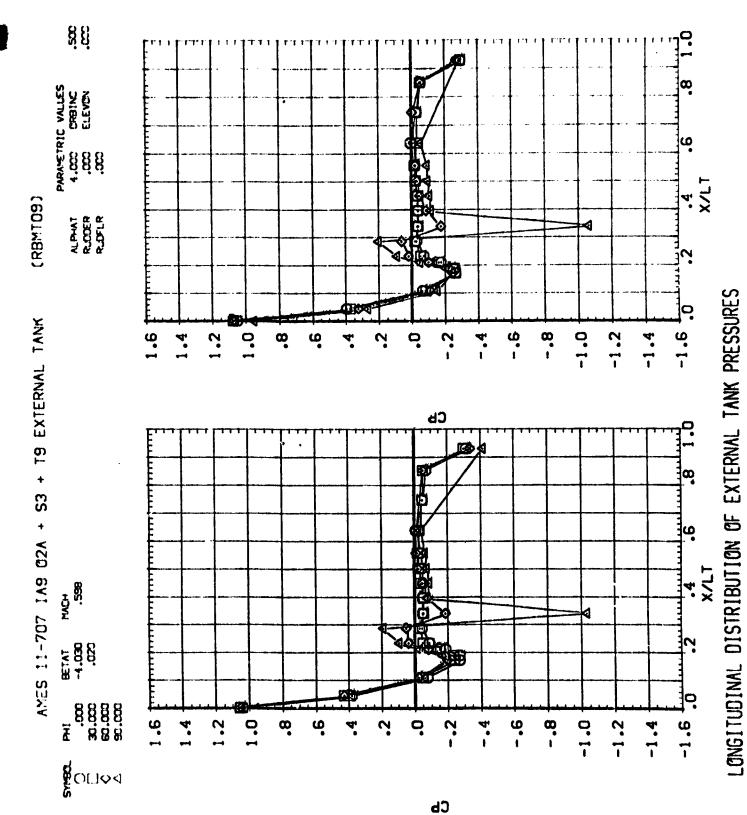


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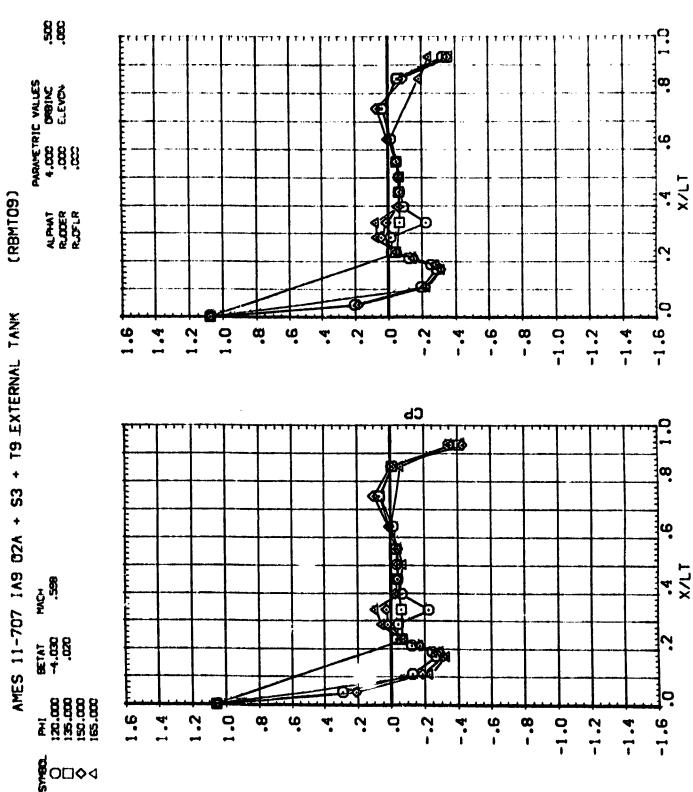
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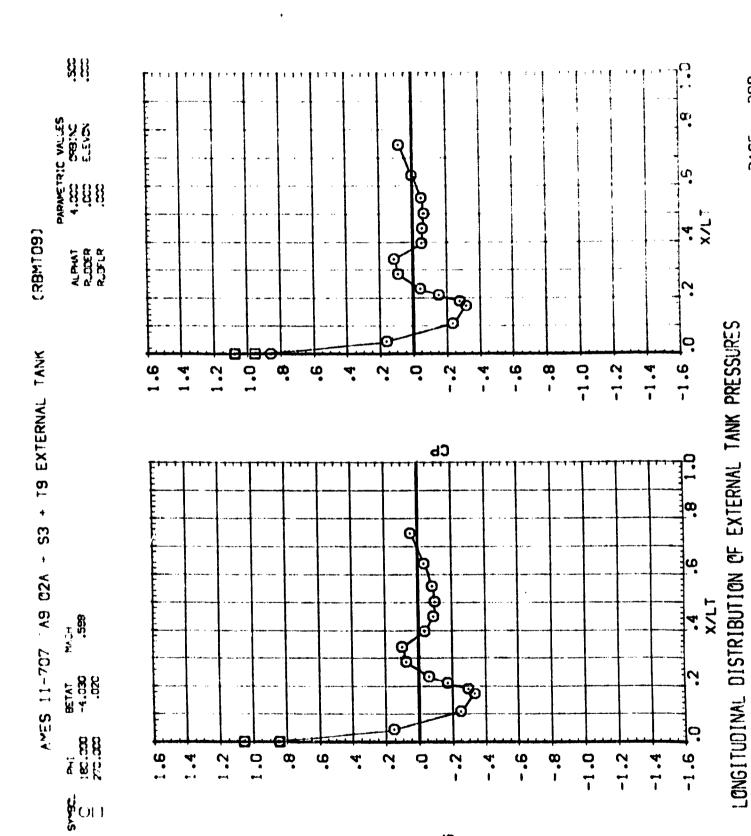


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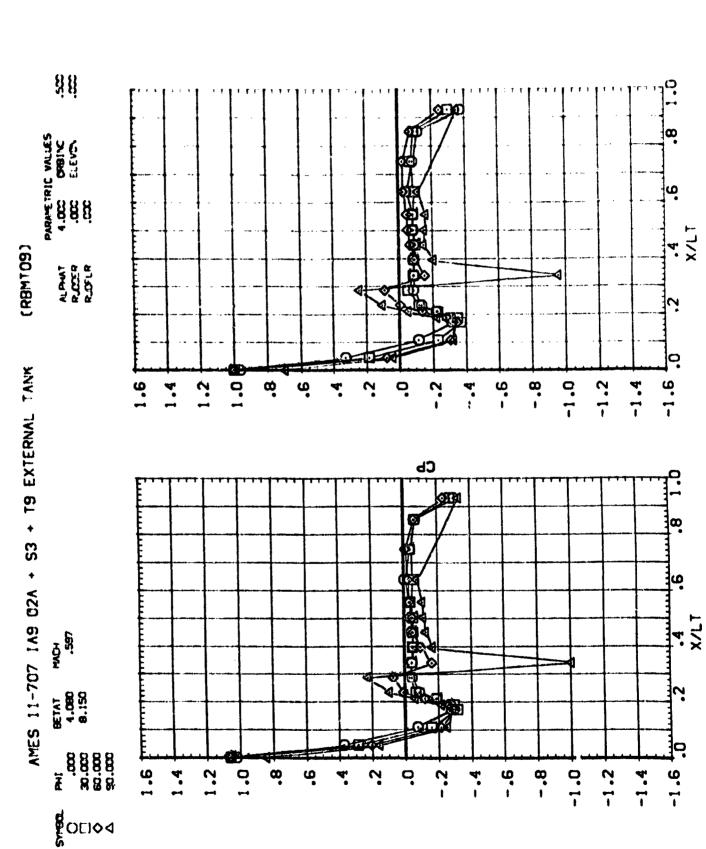
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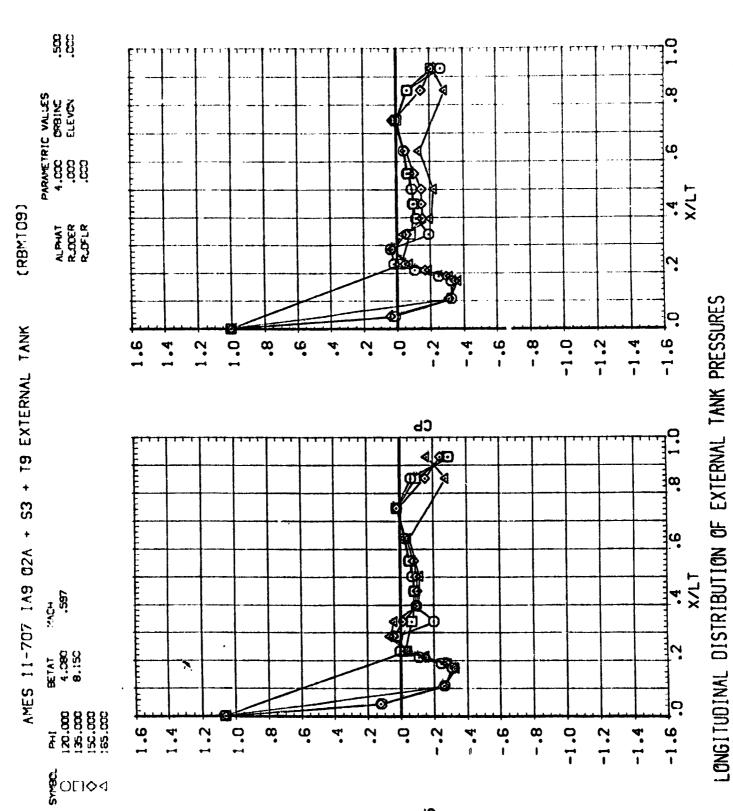
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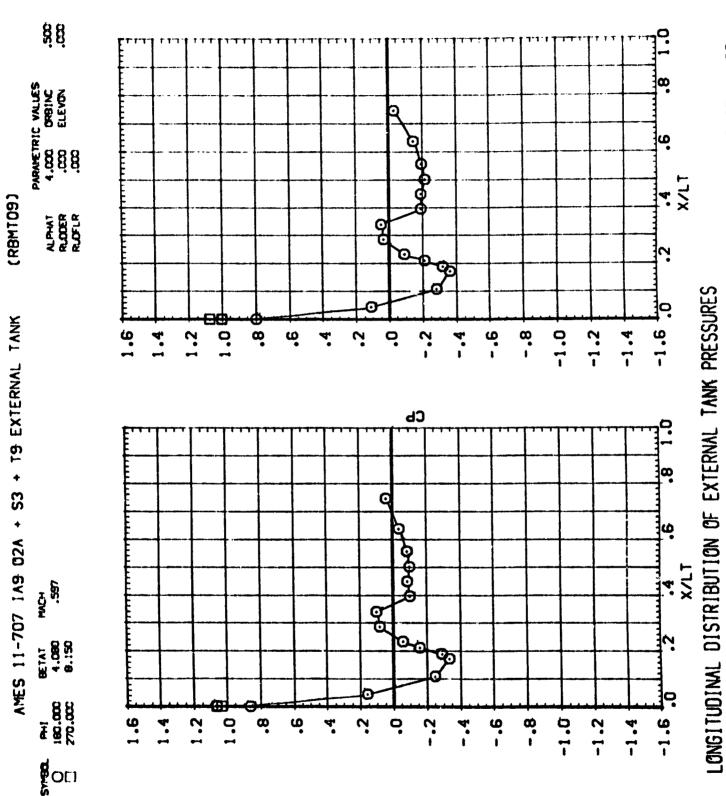
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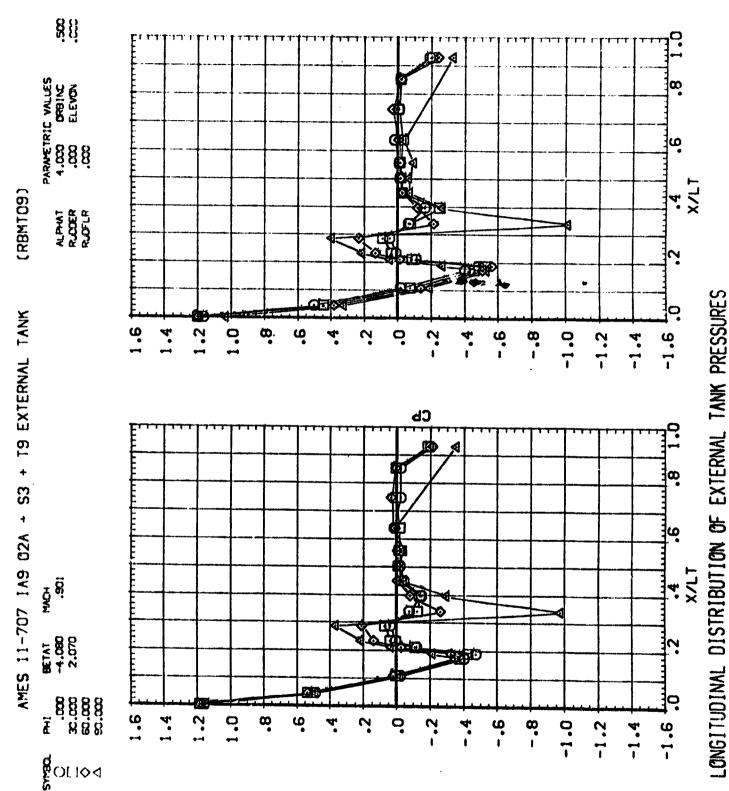
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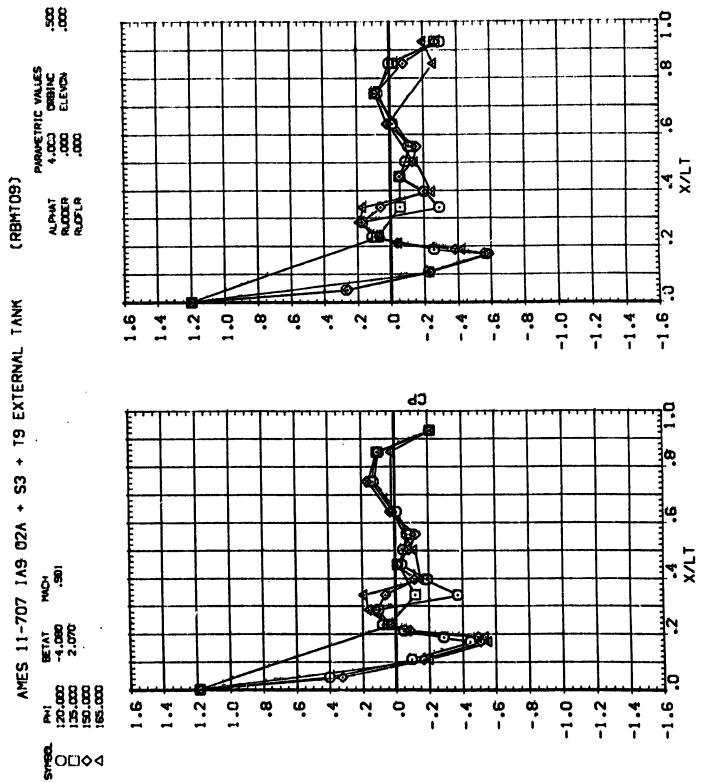


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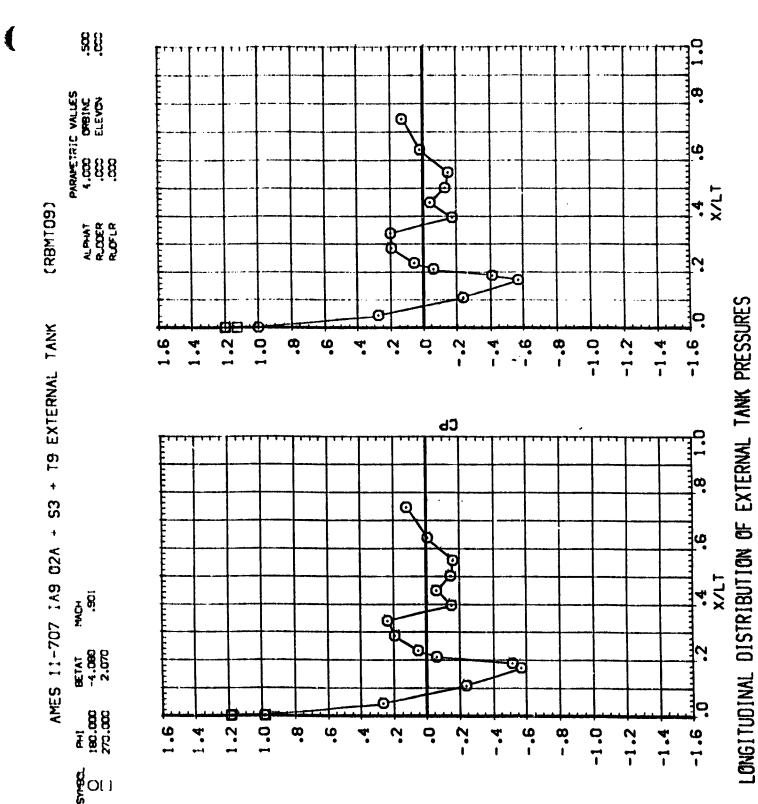
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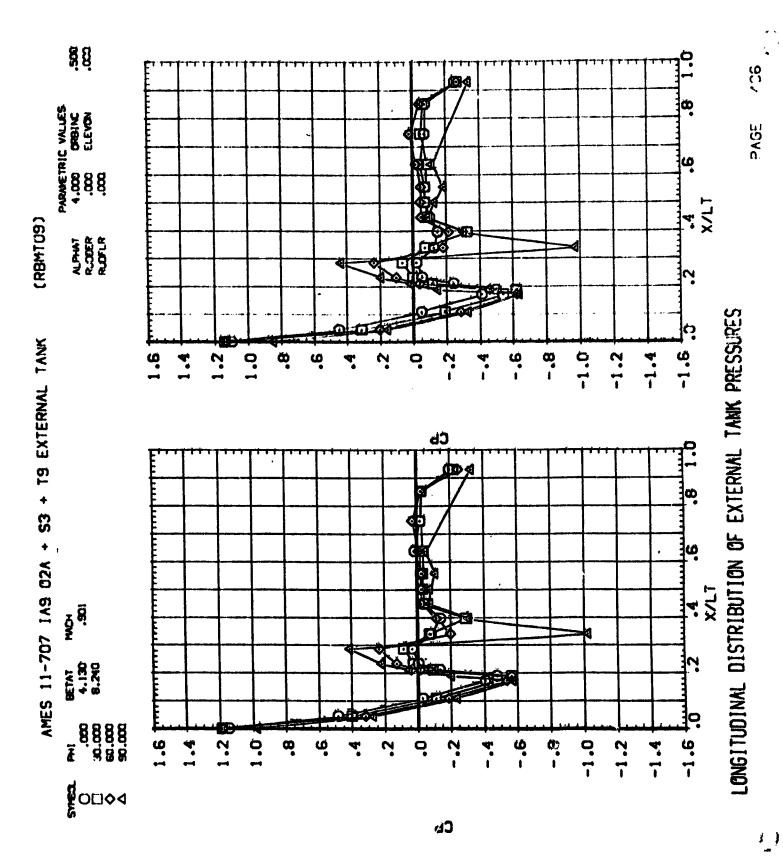


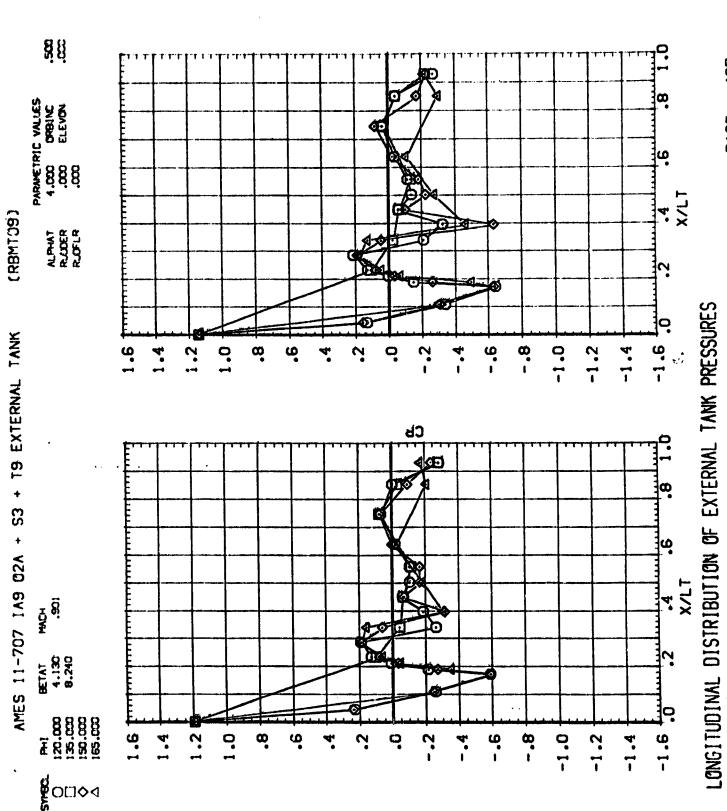
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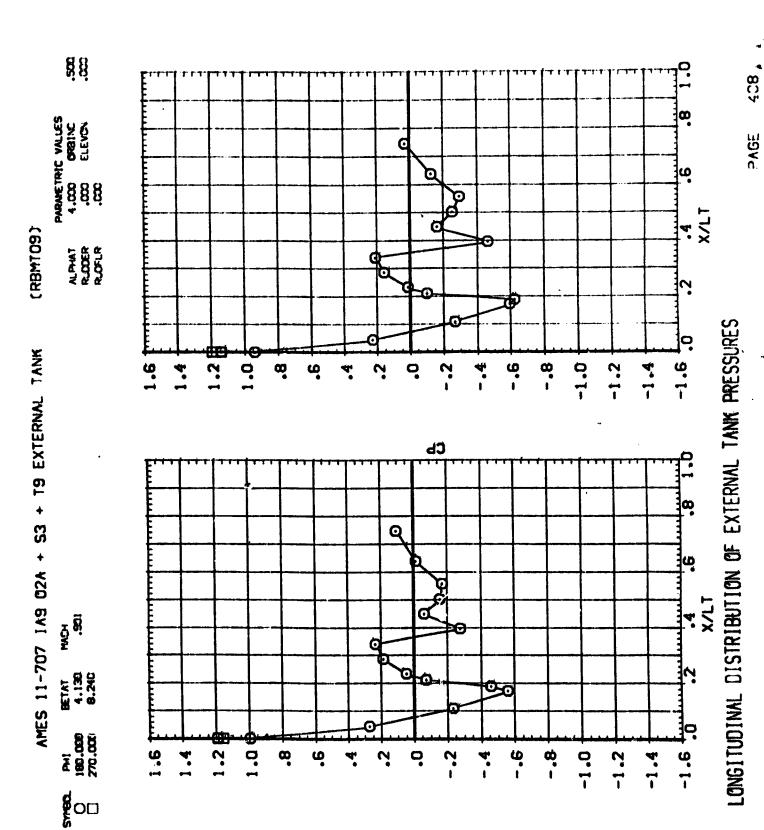
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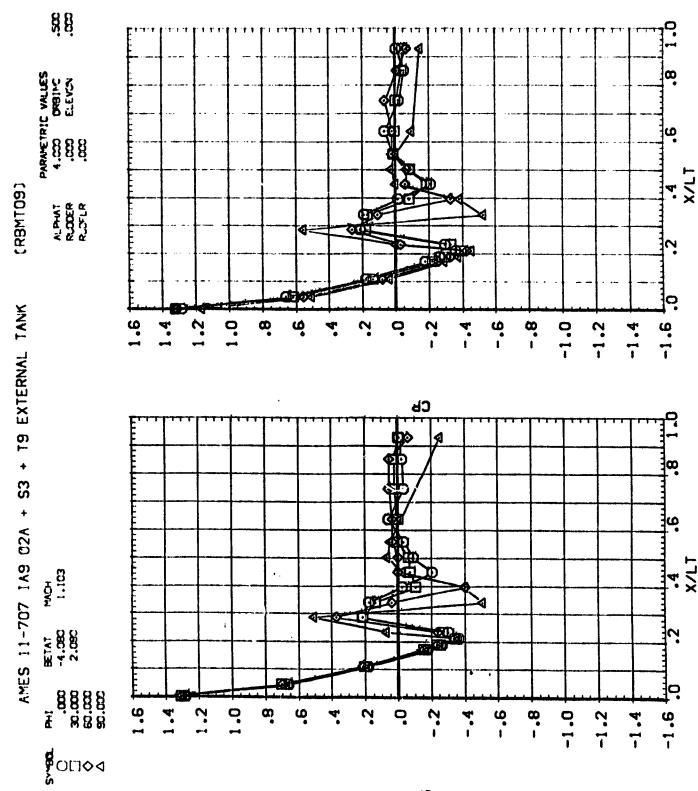
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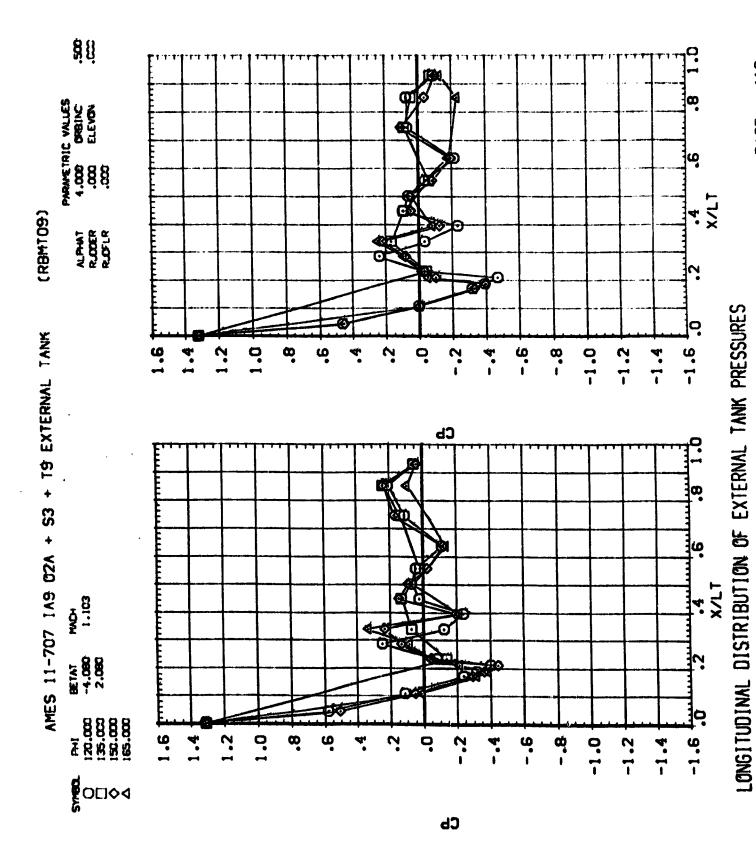


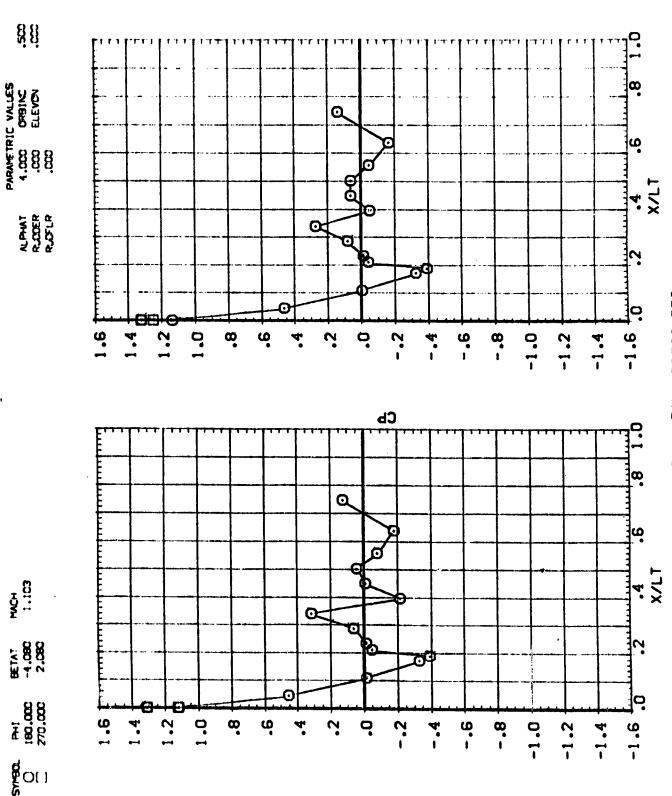
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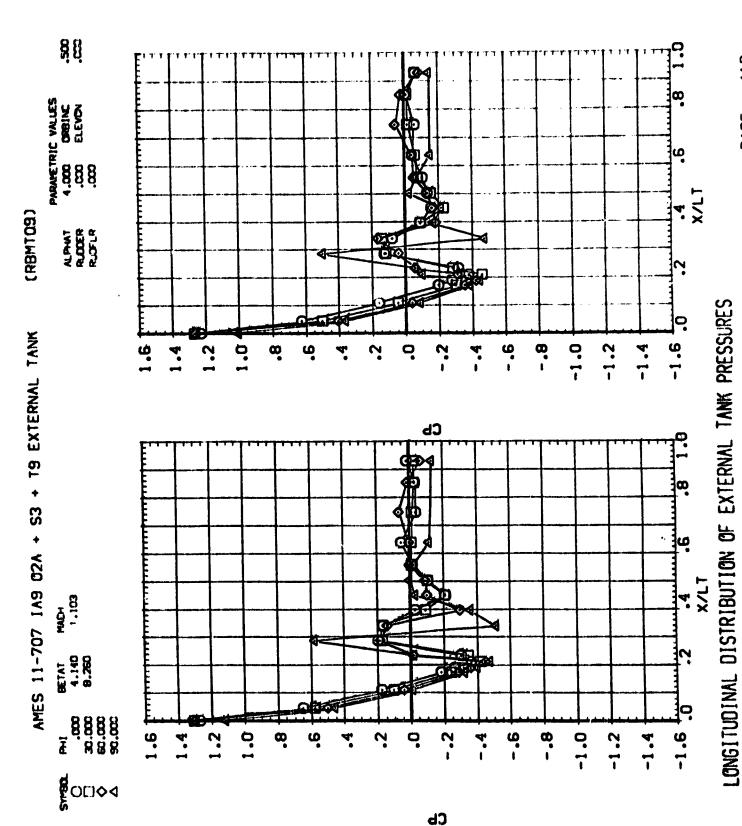


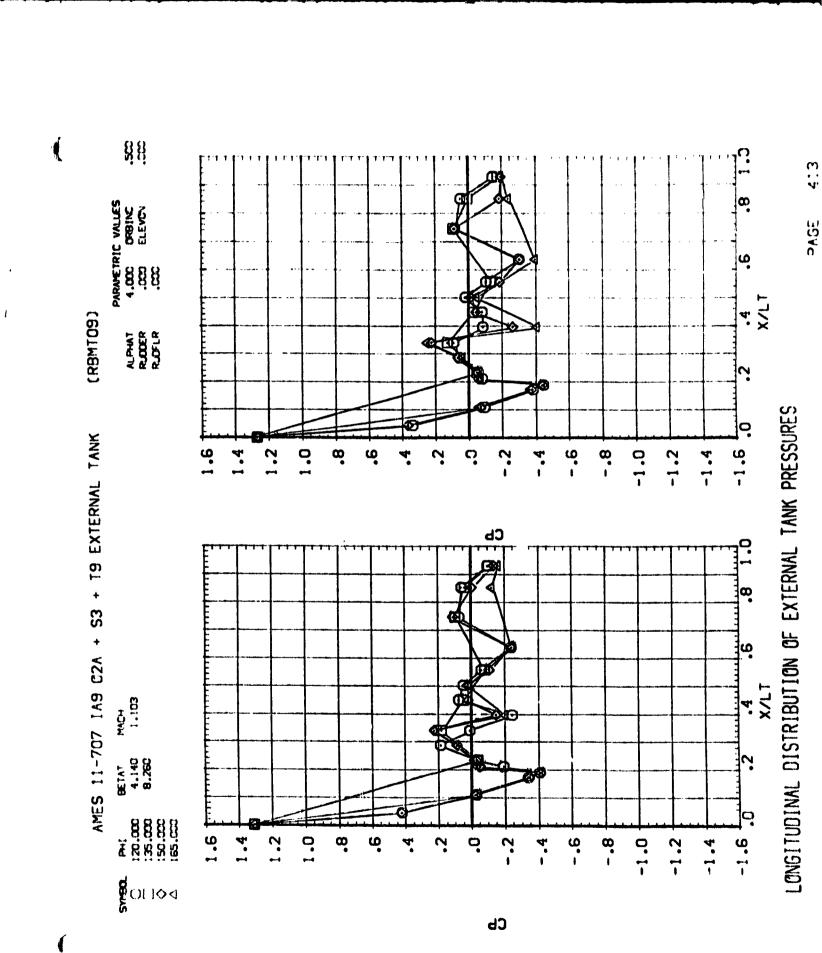


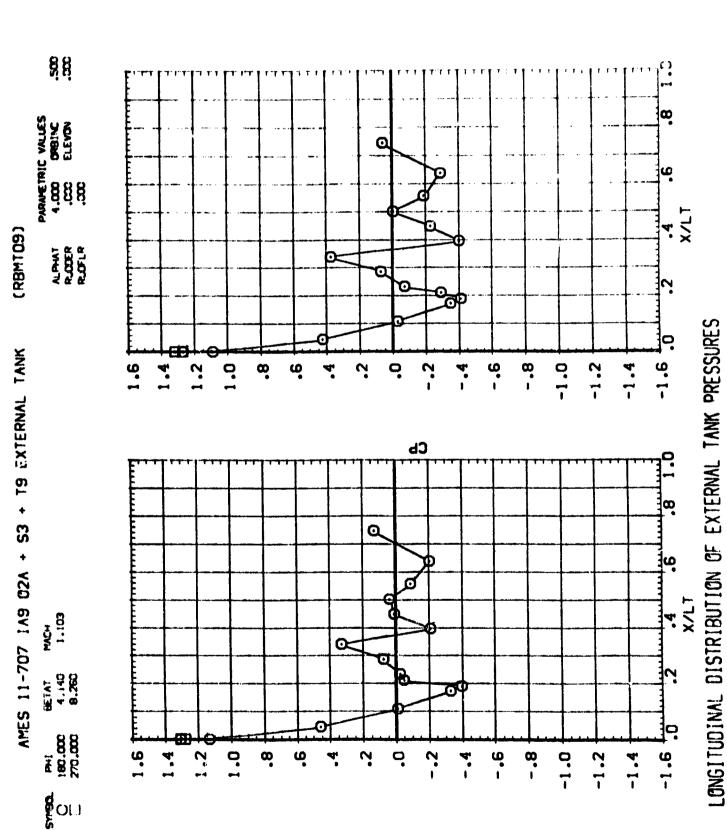
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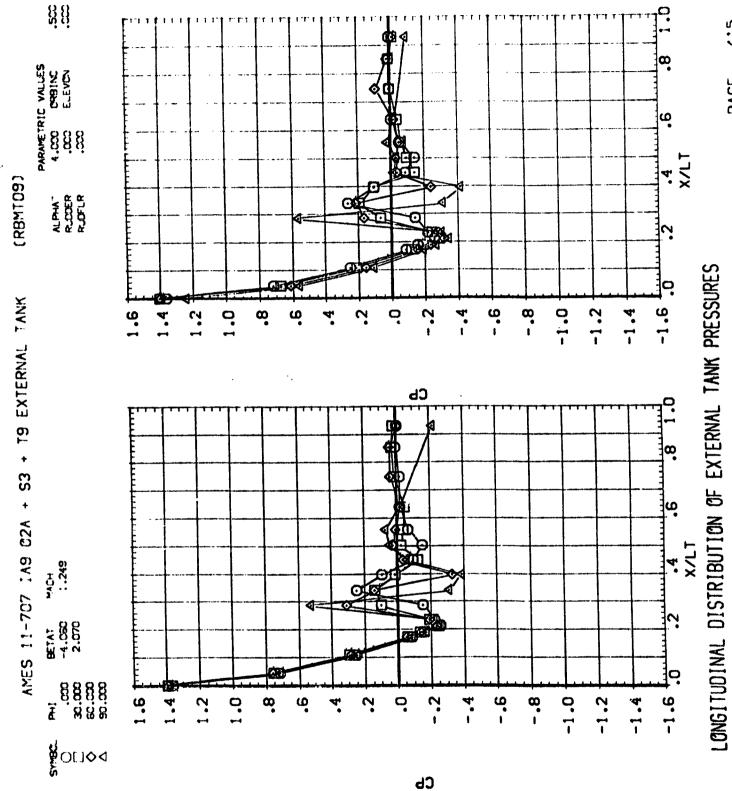
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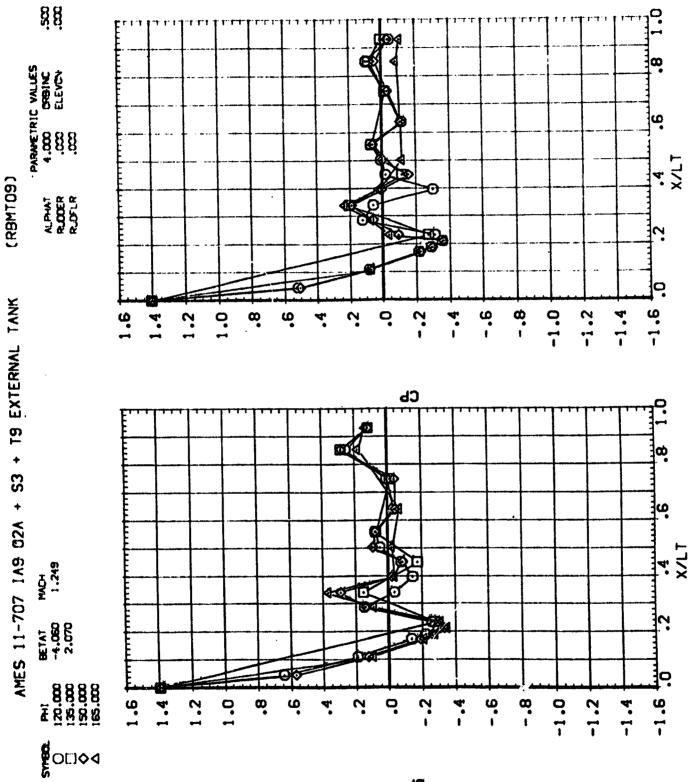






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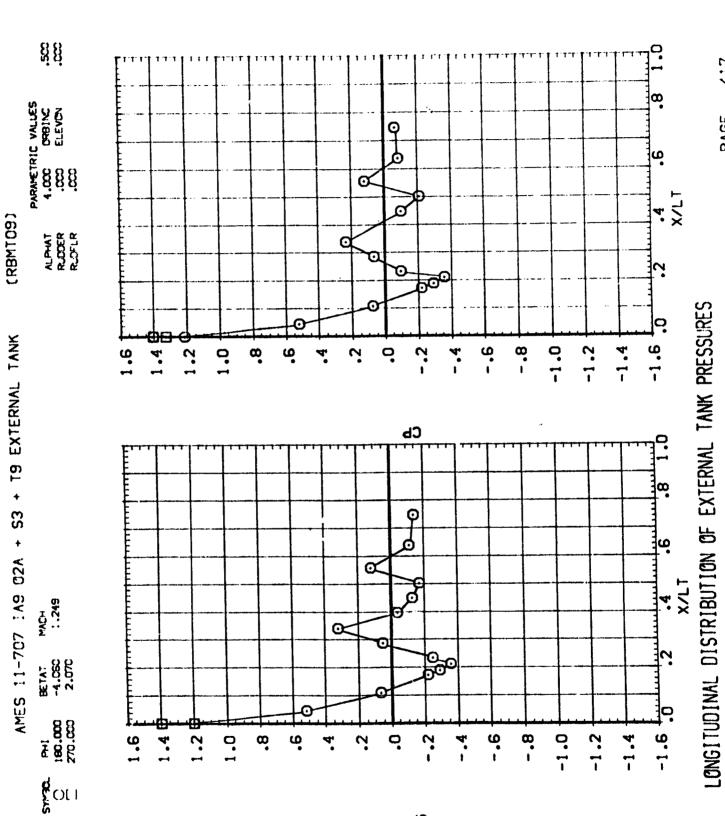




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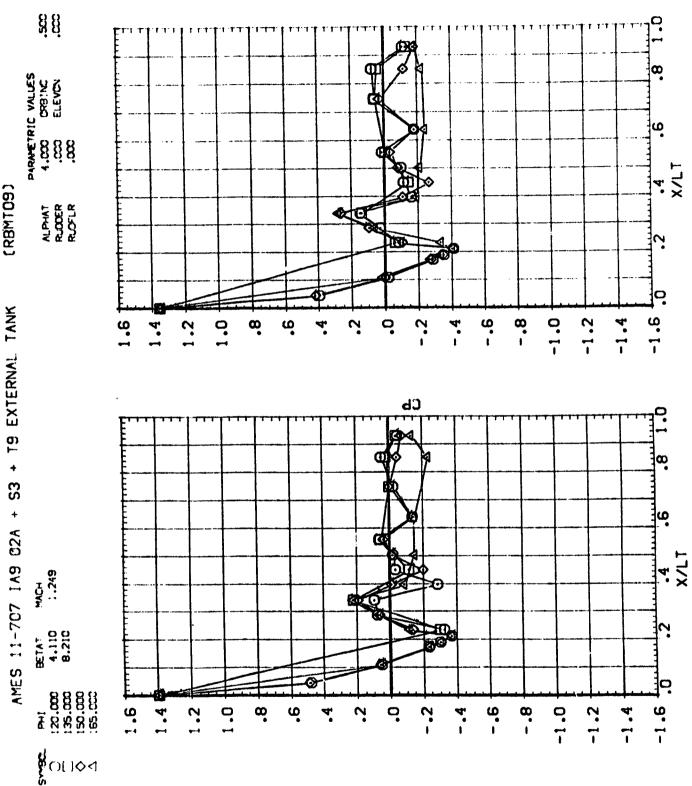
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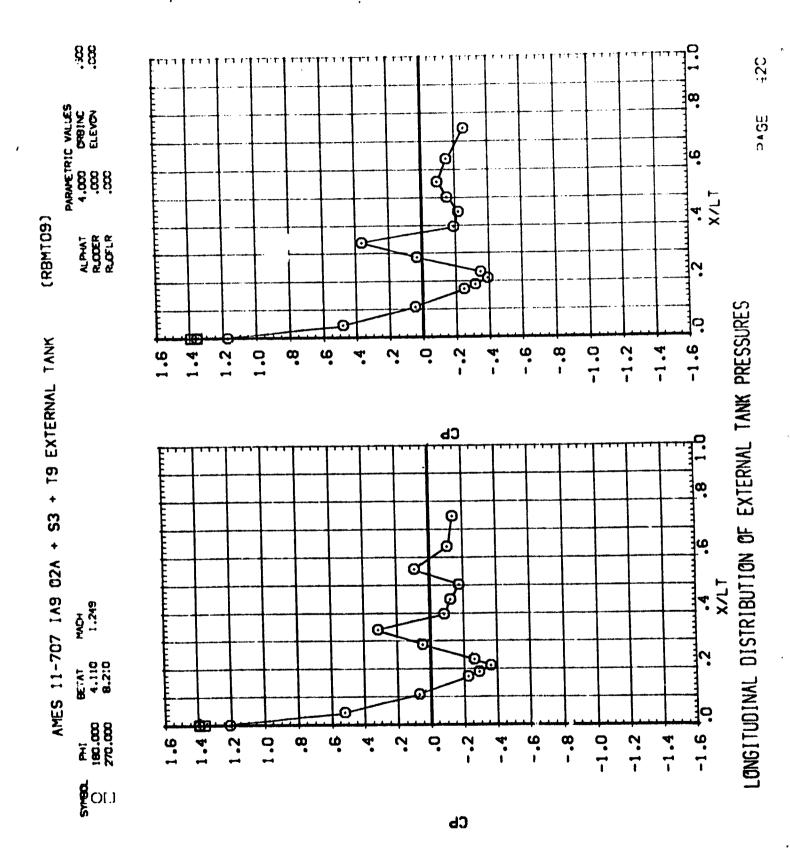
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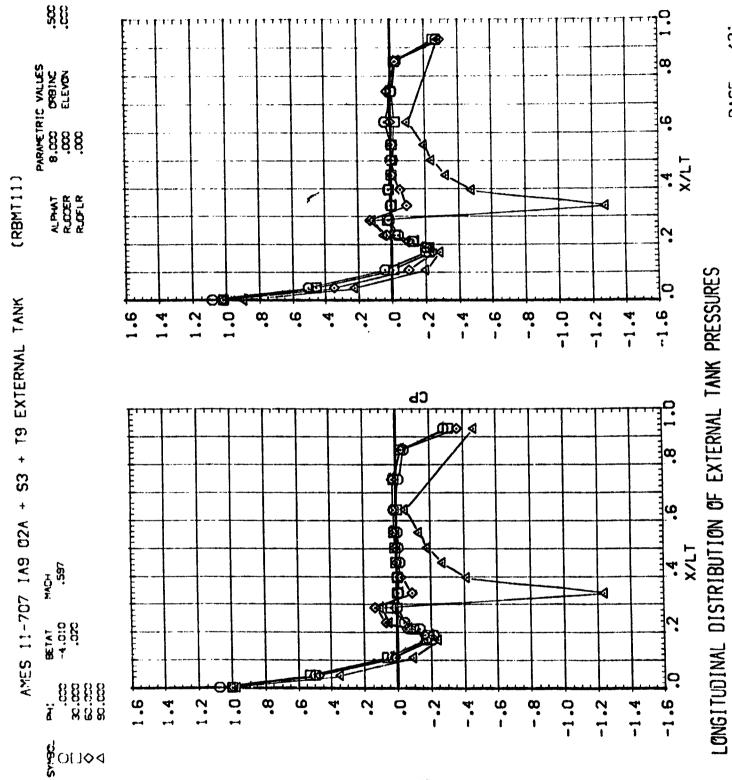
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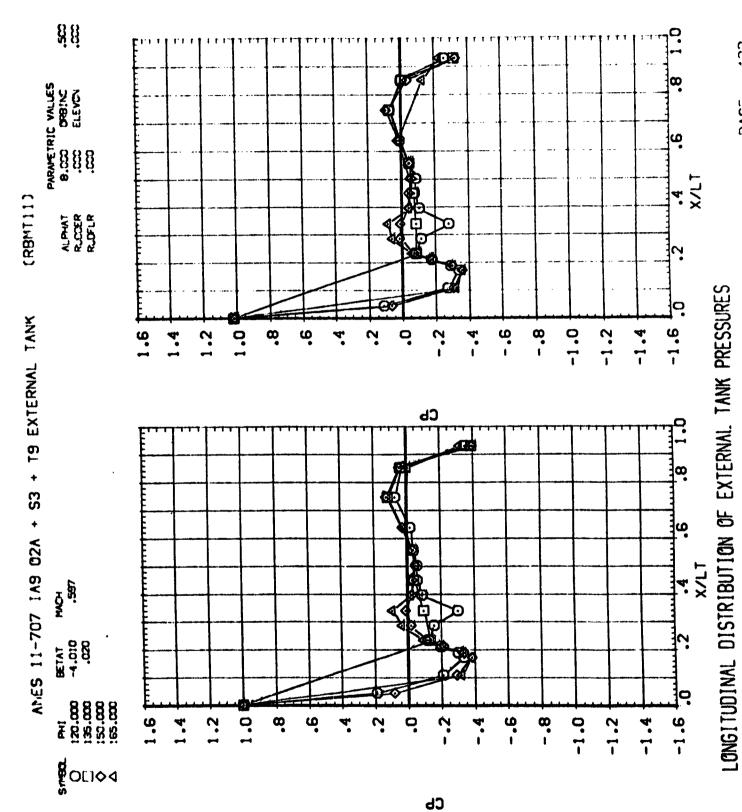
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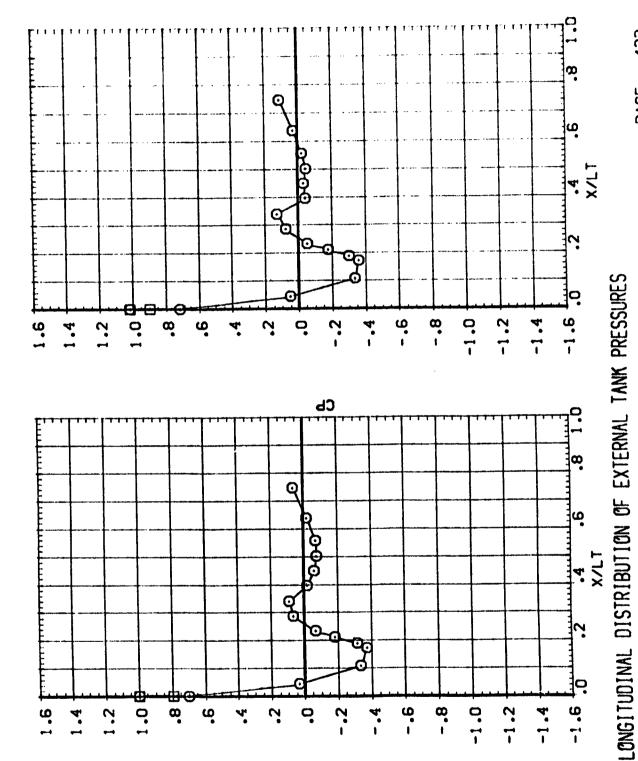
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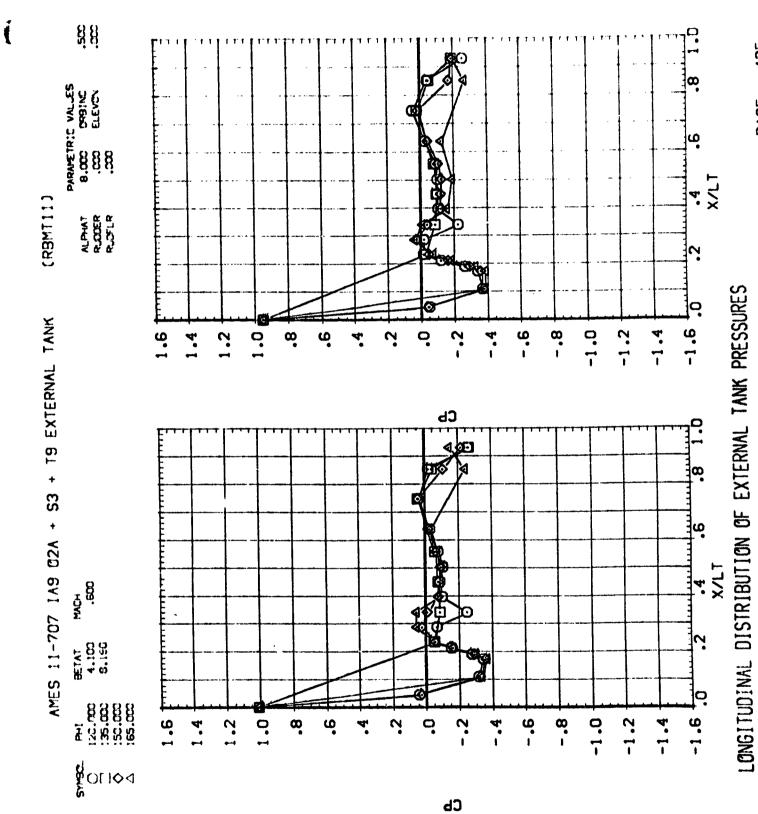
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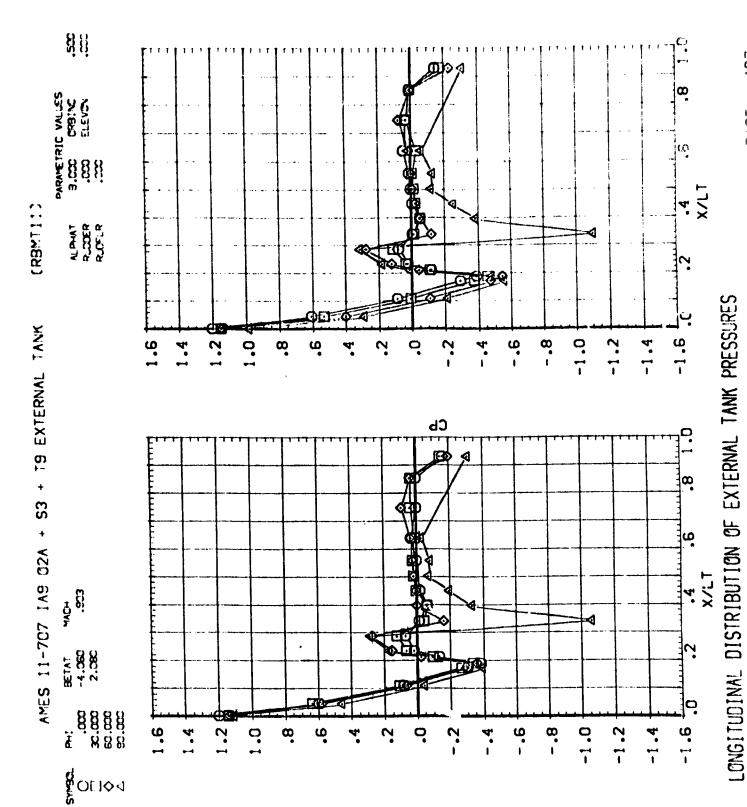
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LONGITUDINAL DISTRIBUTION OF EXTERNAL TANK PRESSURES

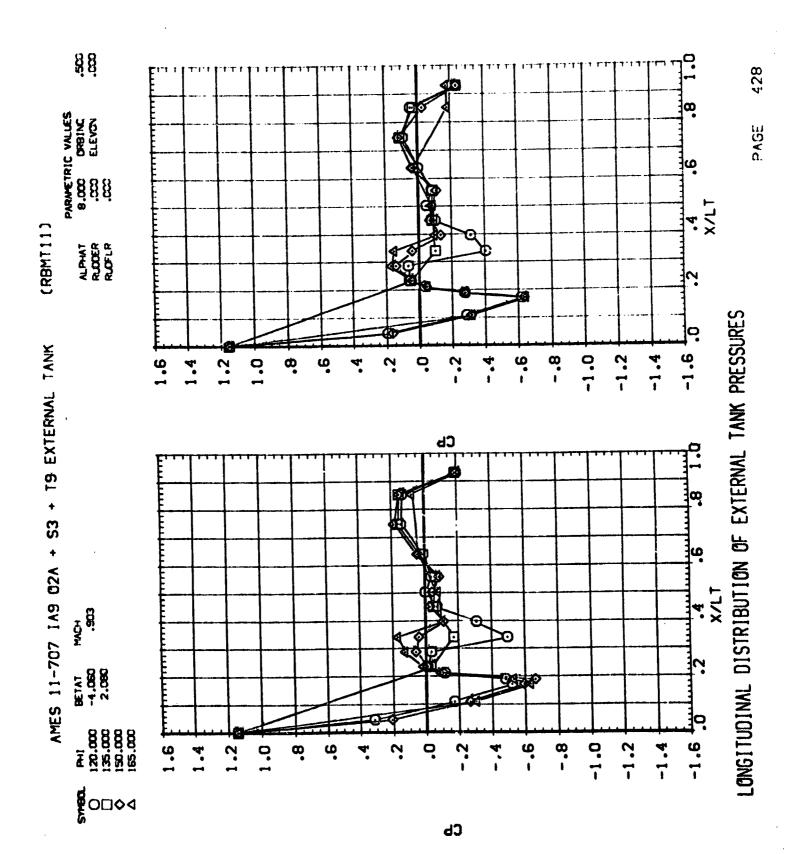
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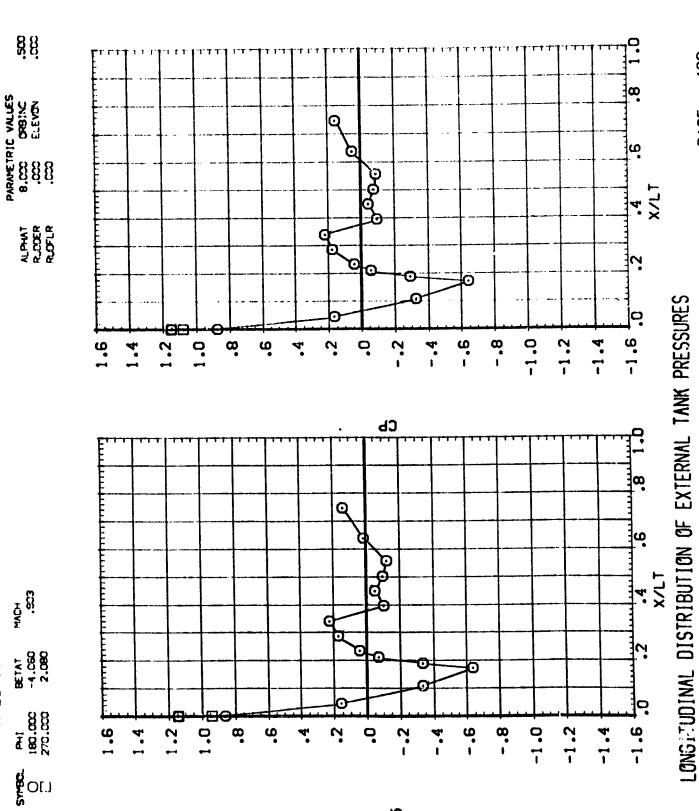


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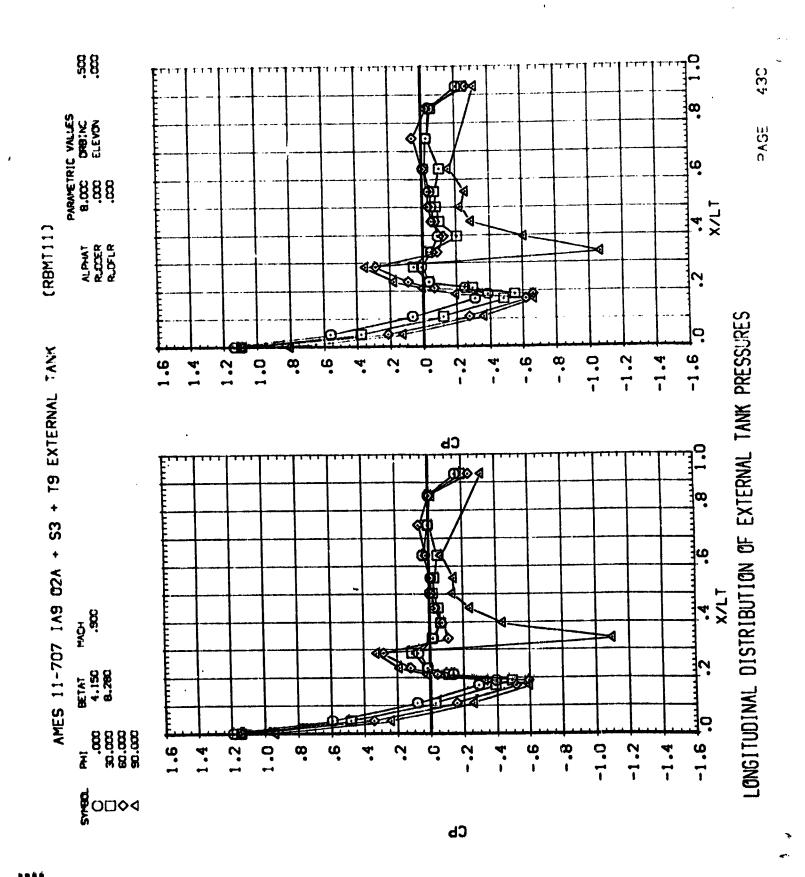


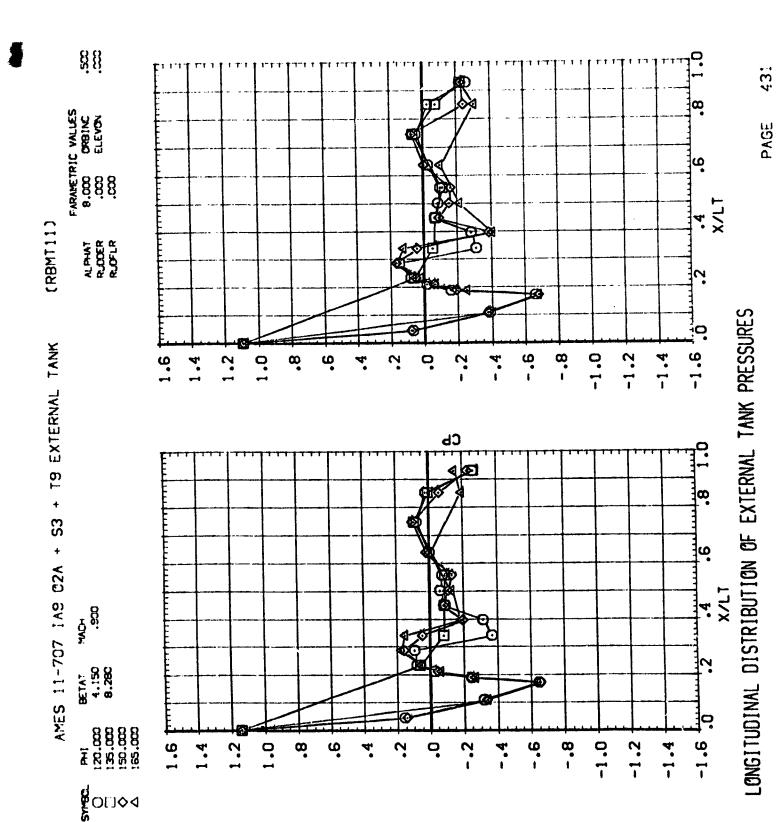
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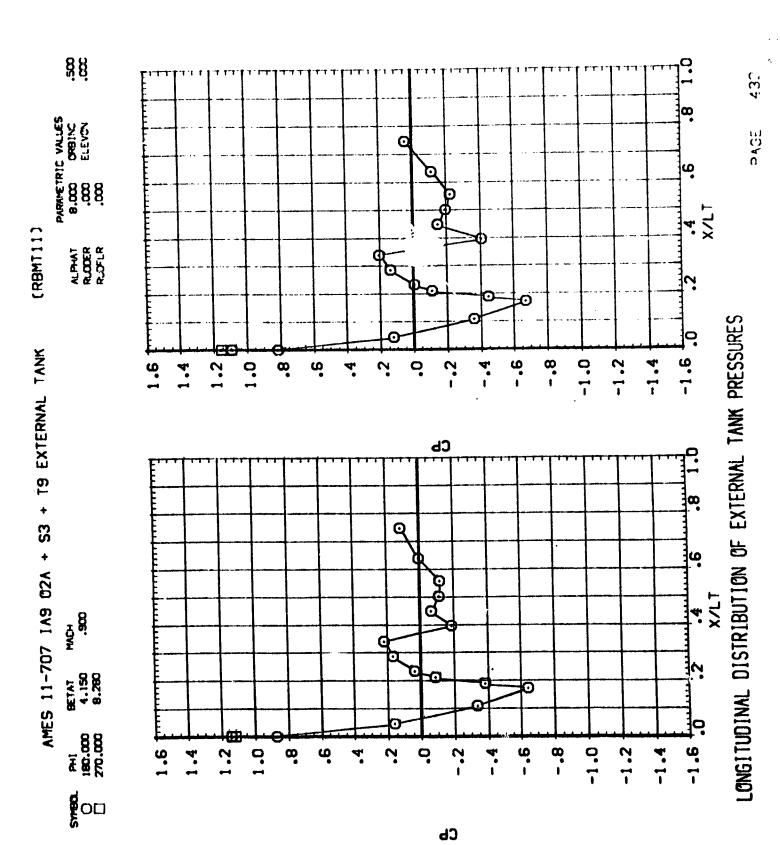
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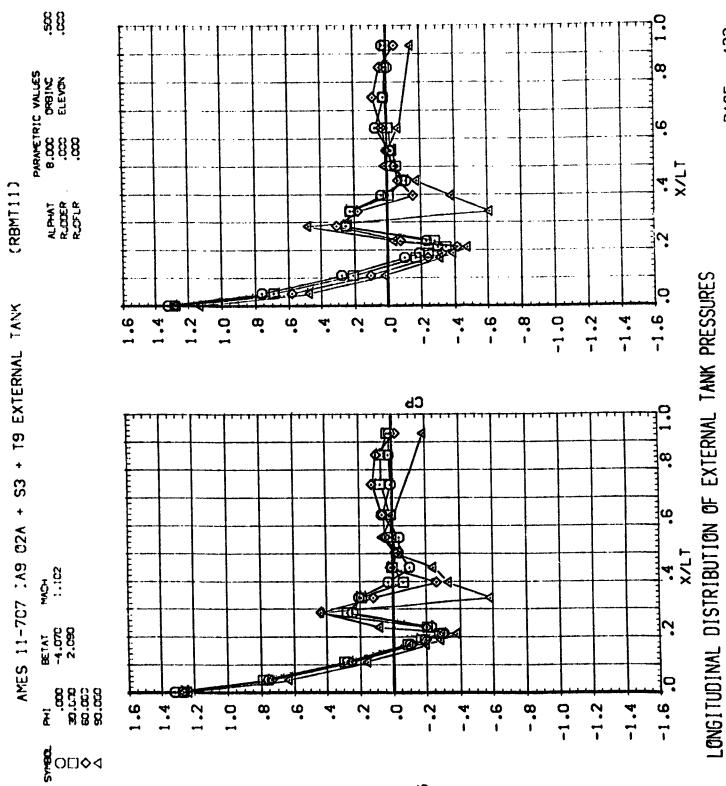




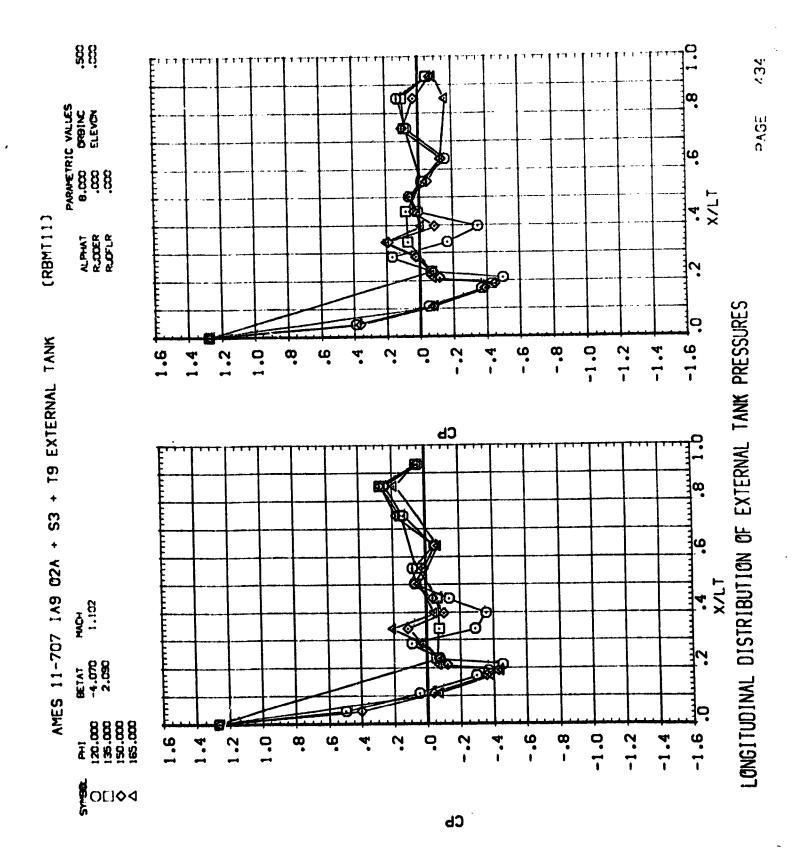
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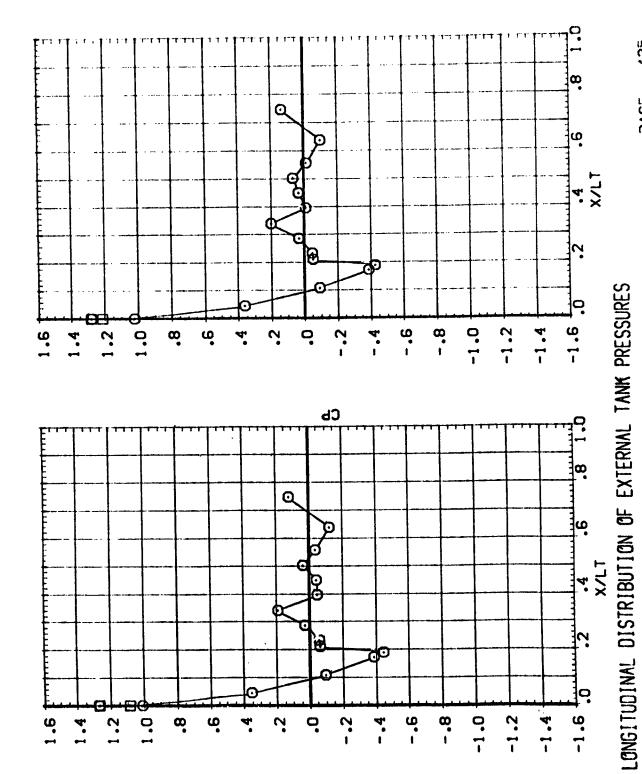




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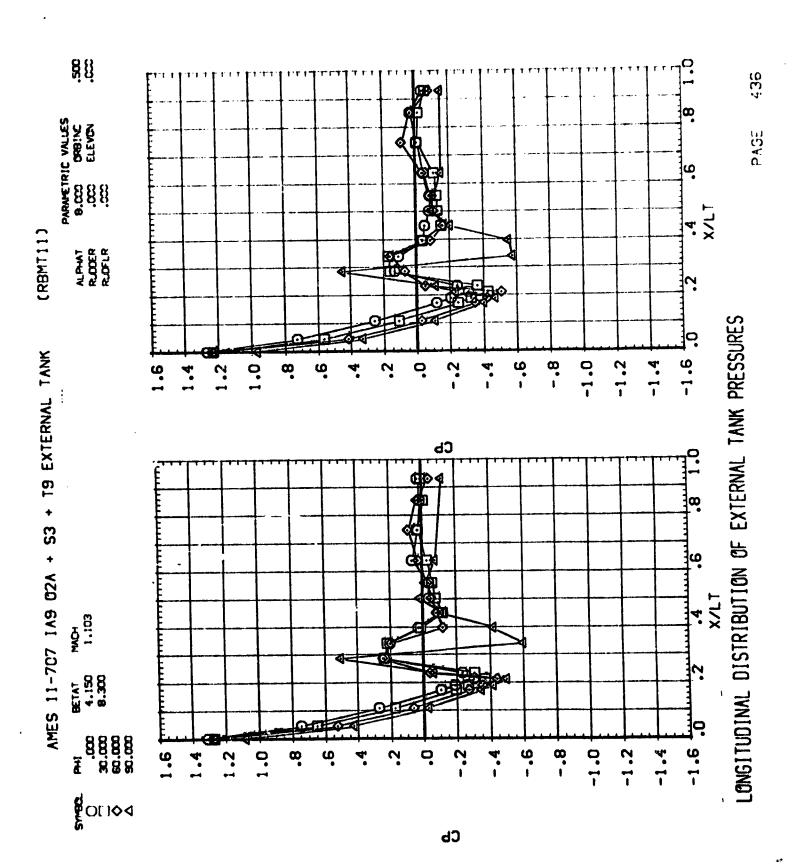
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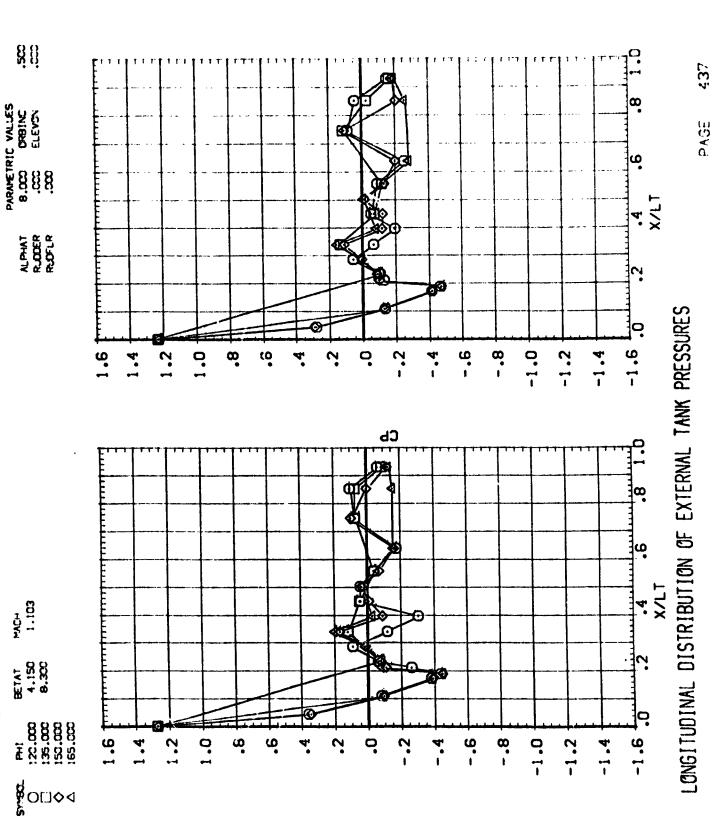
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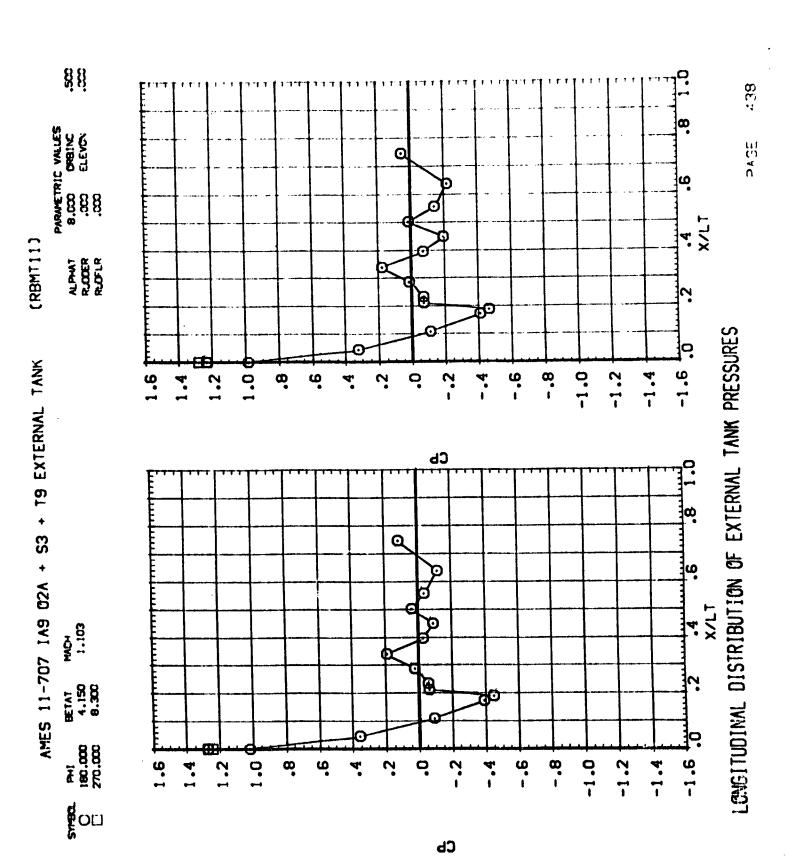




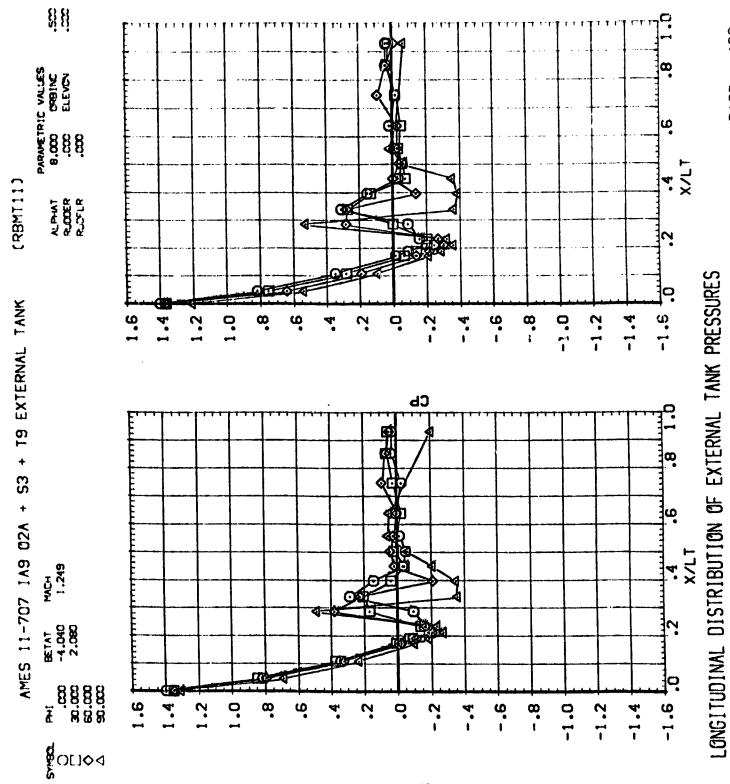
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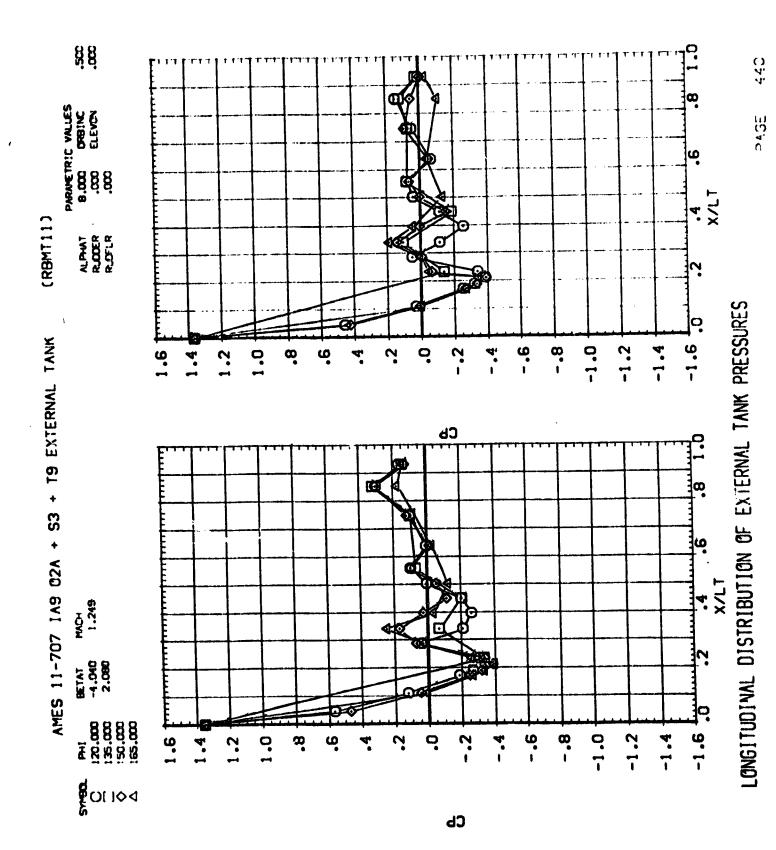
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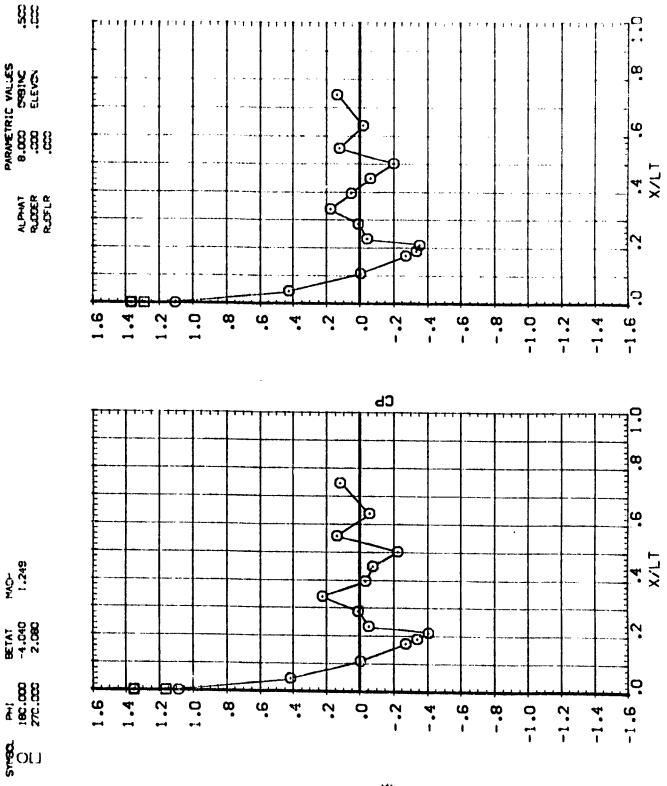




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LONGITUDINAL DISTRIBUTION OF EXTERNAL TANK PRESSURES

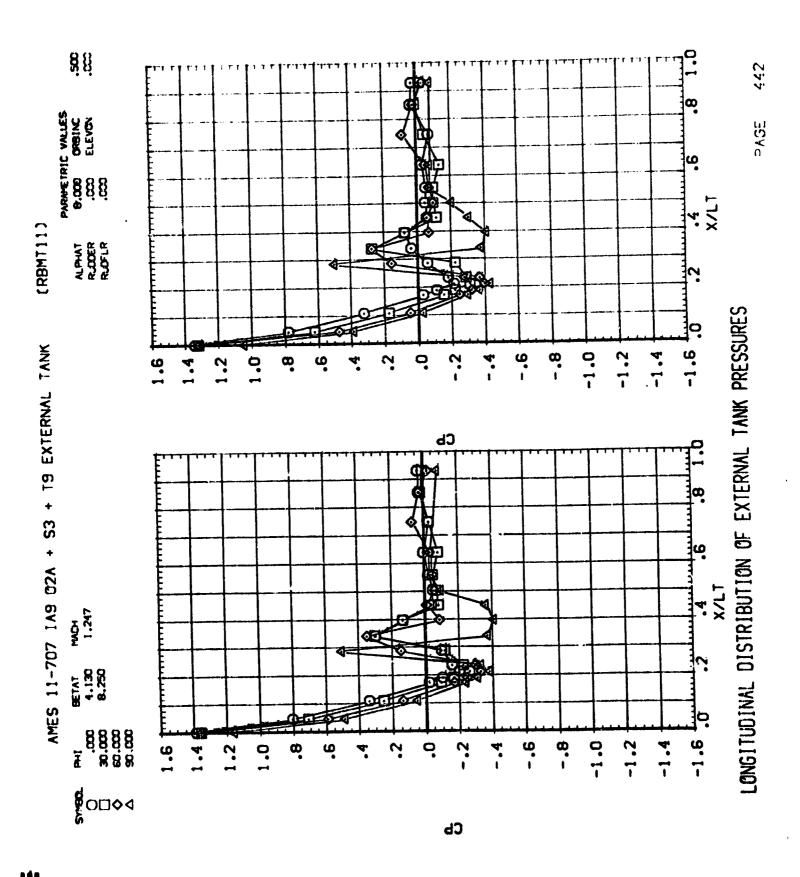


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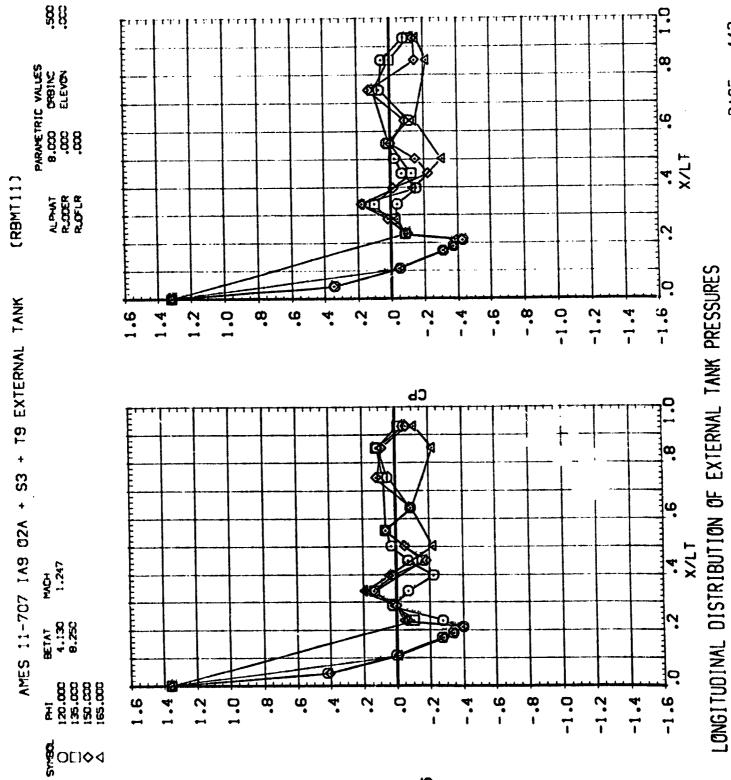
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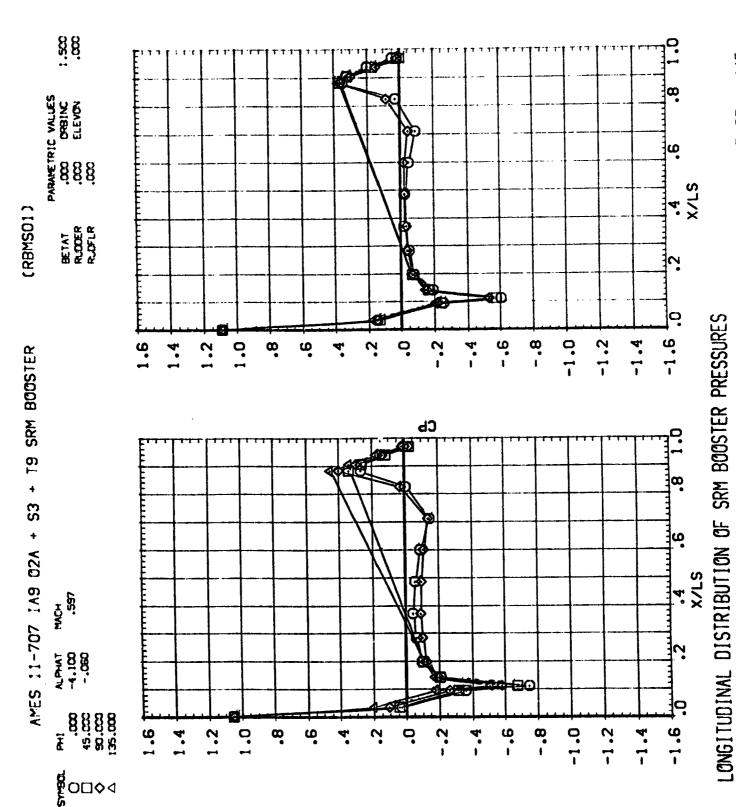
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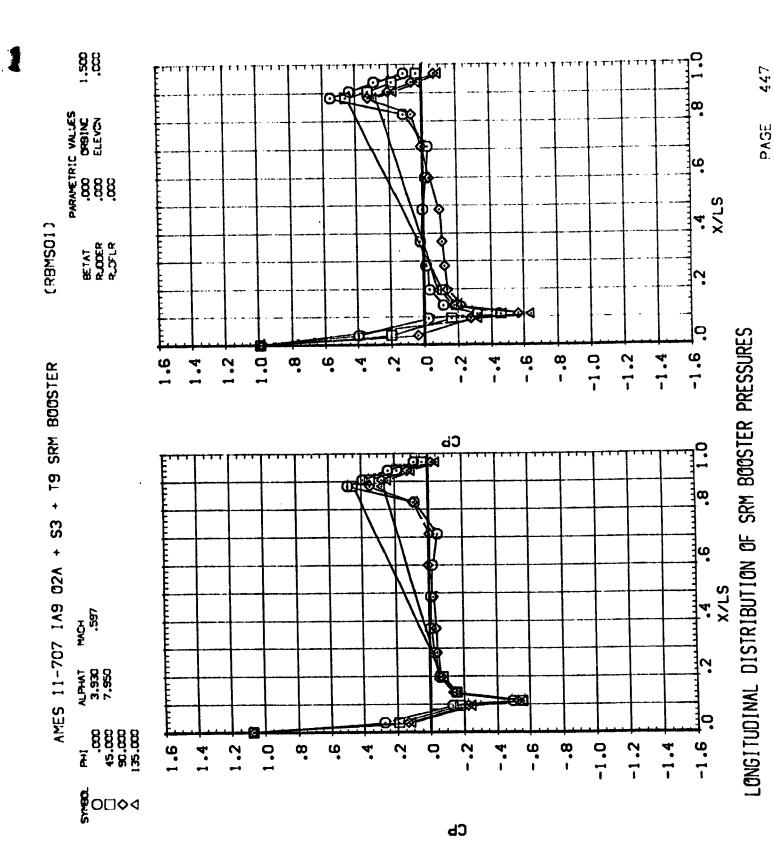
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LONGITUDINAL DISTRIBUTION OF SRM BOOSTER PRESSURES

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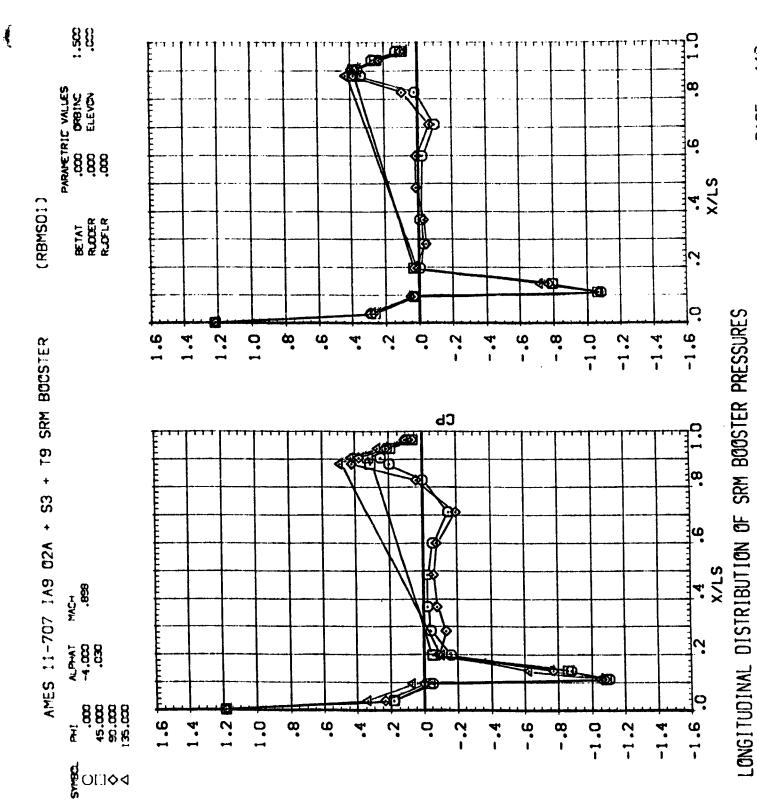


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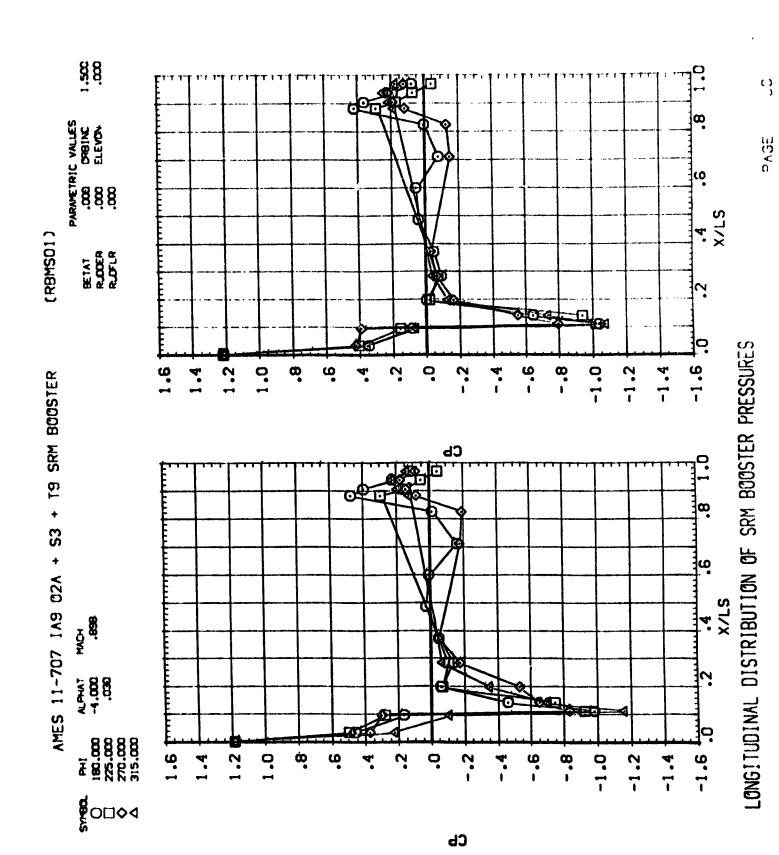
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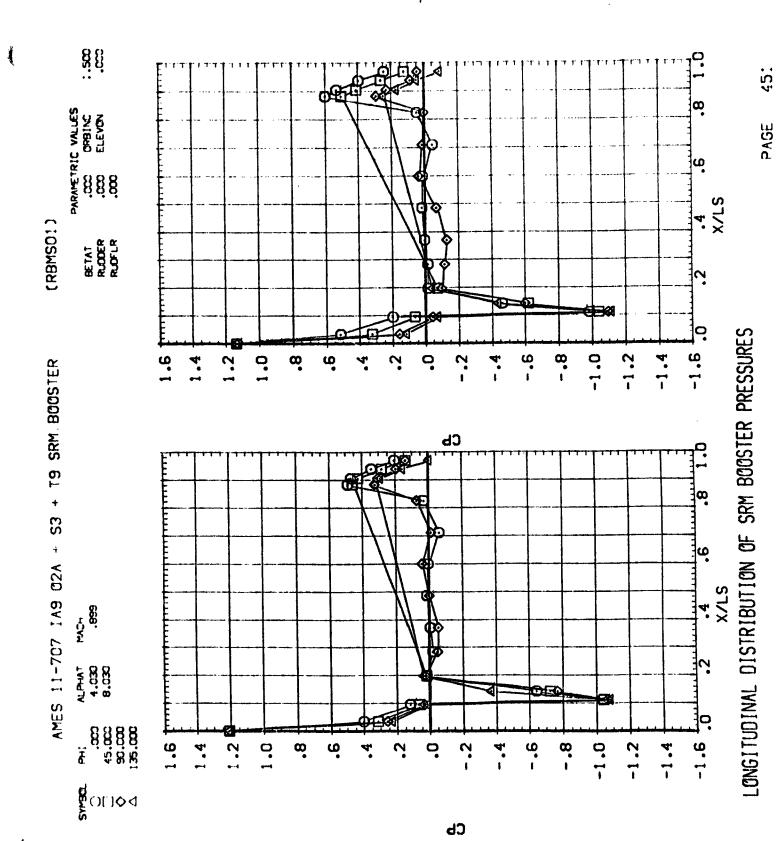
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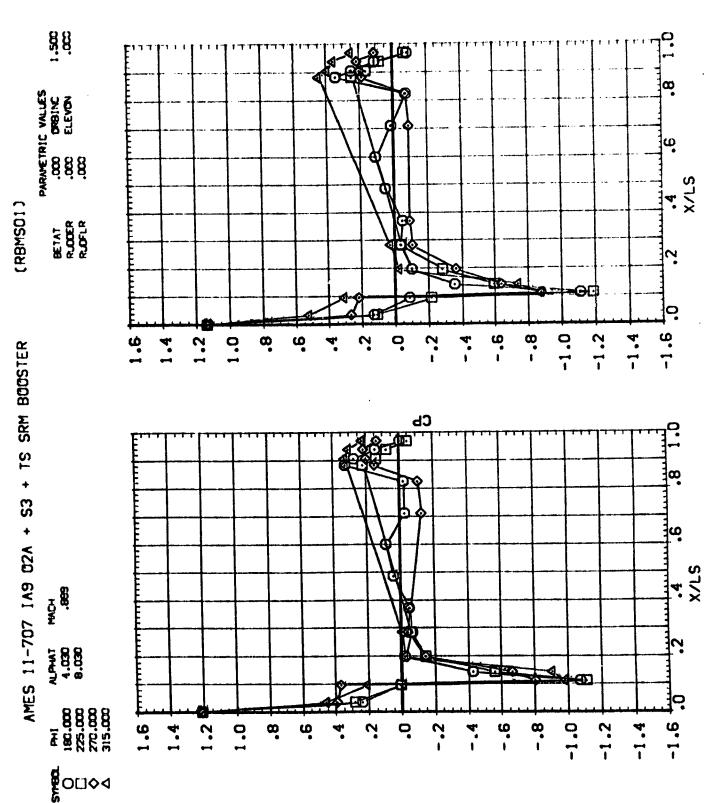
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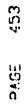
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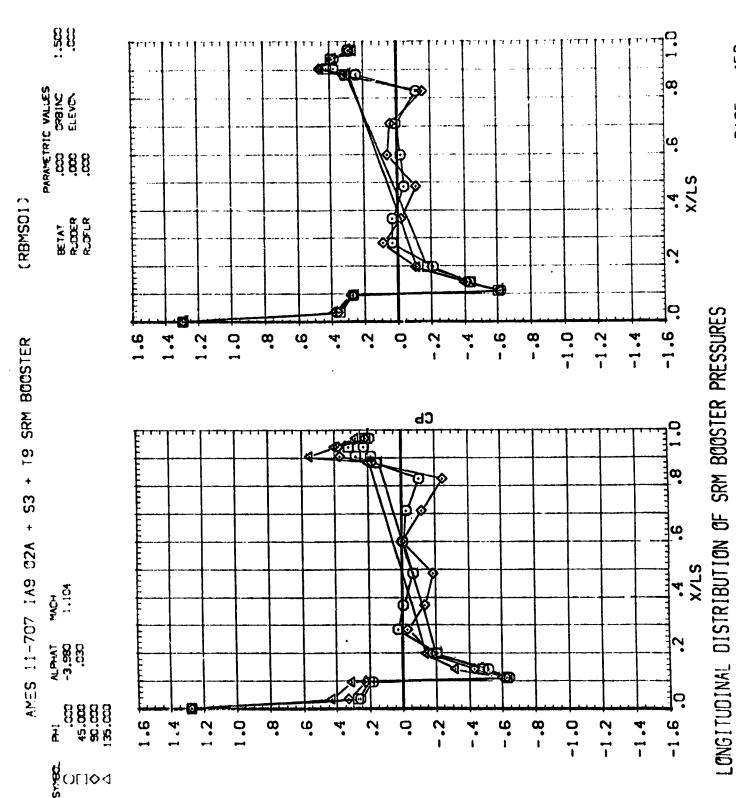






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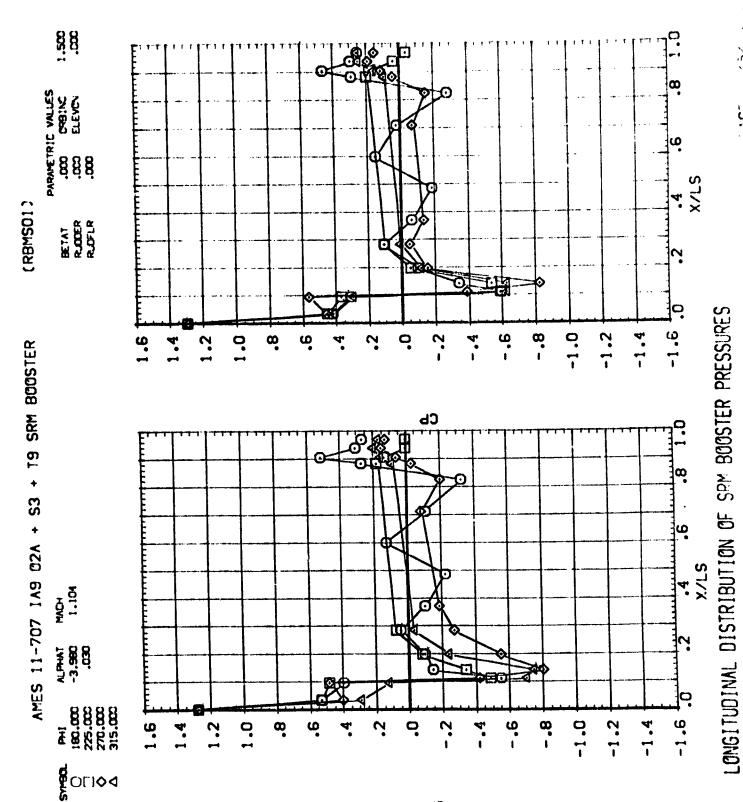




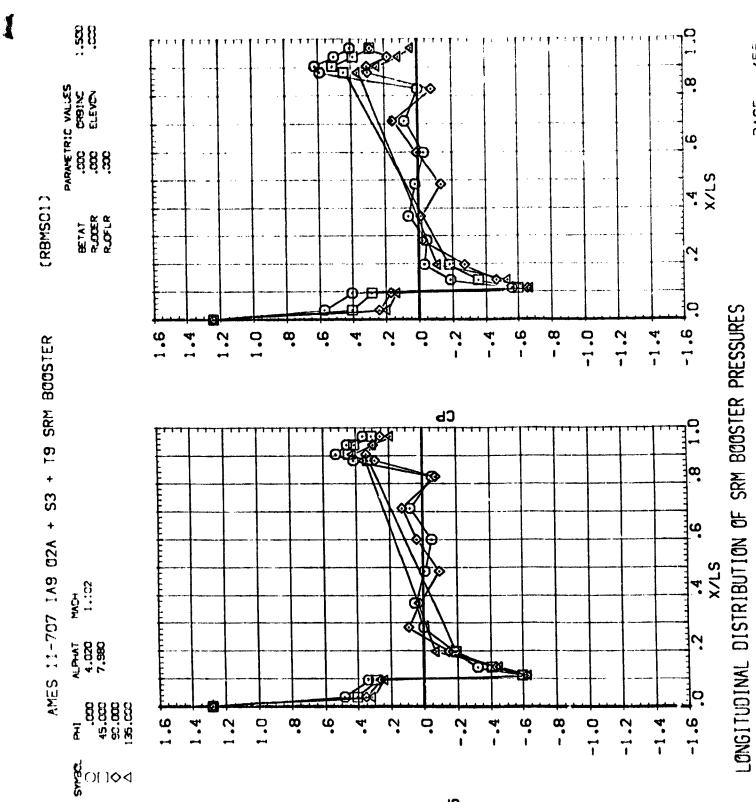
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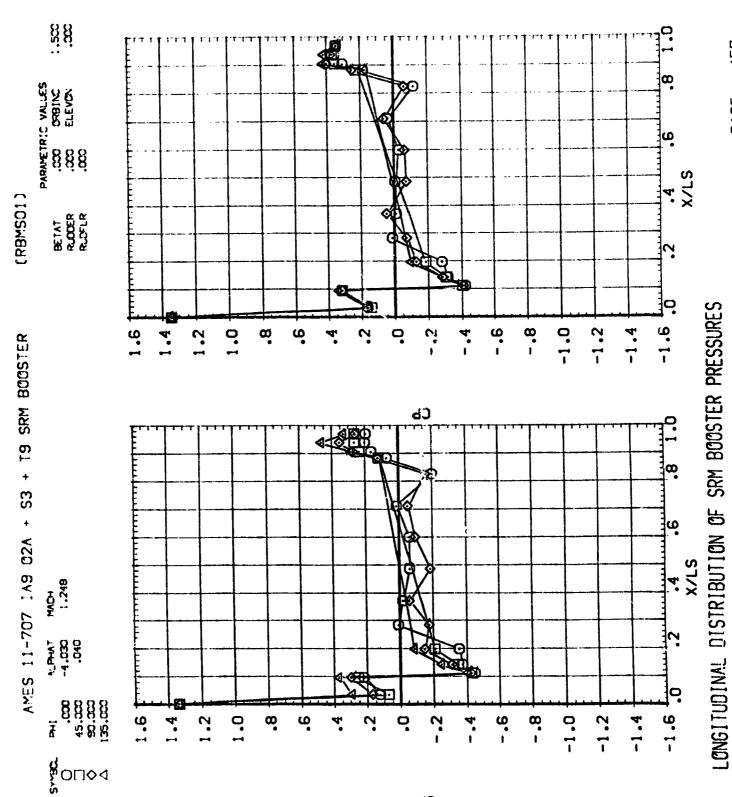
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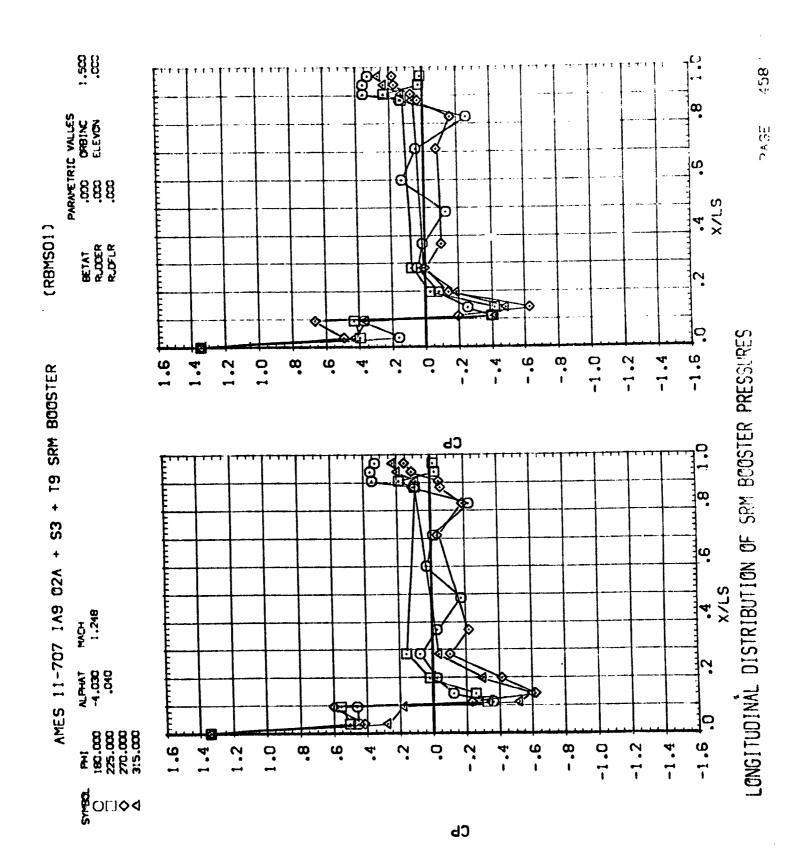


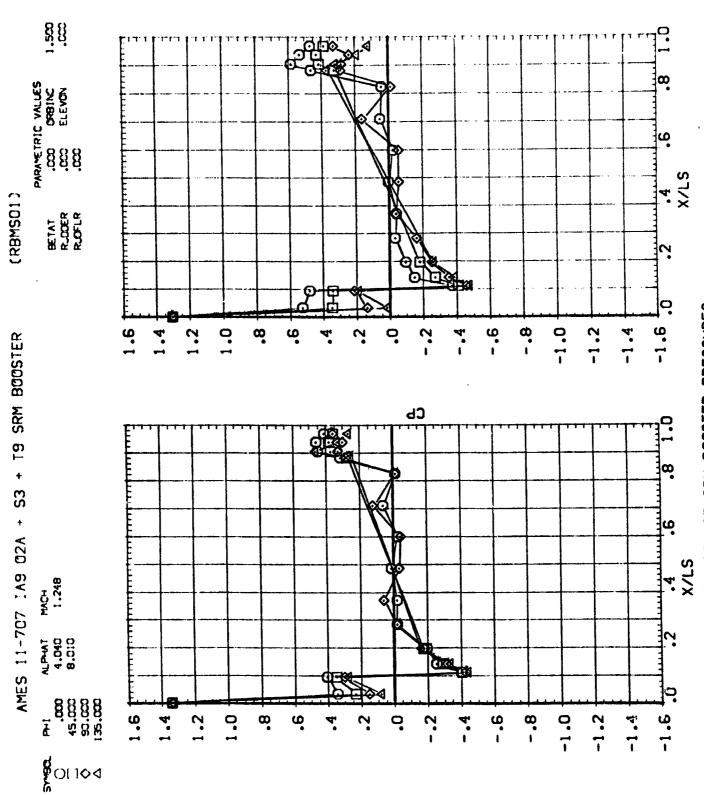
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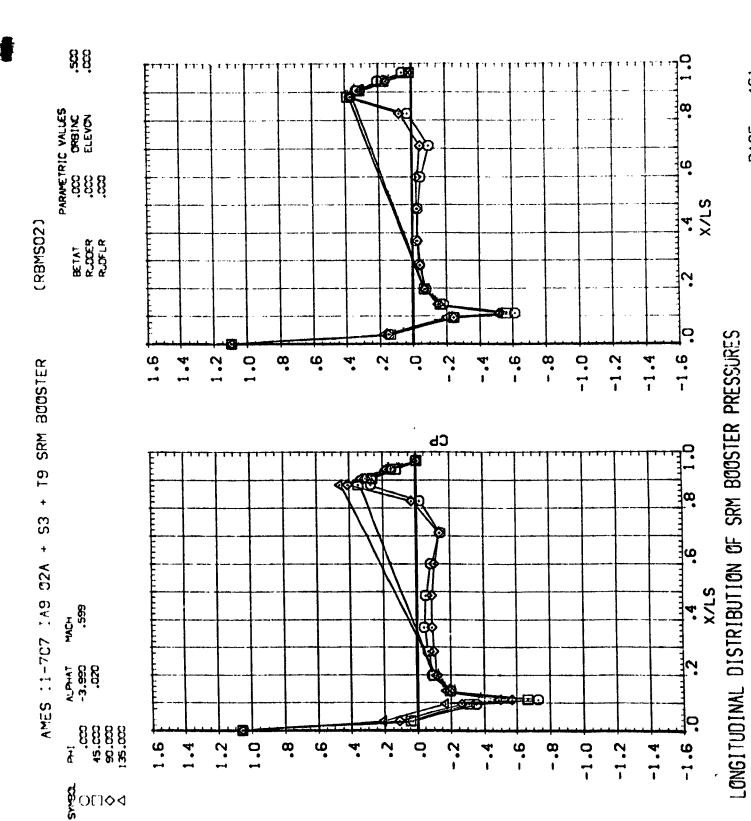
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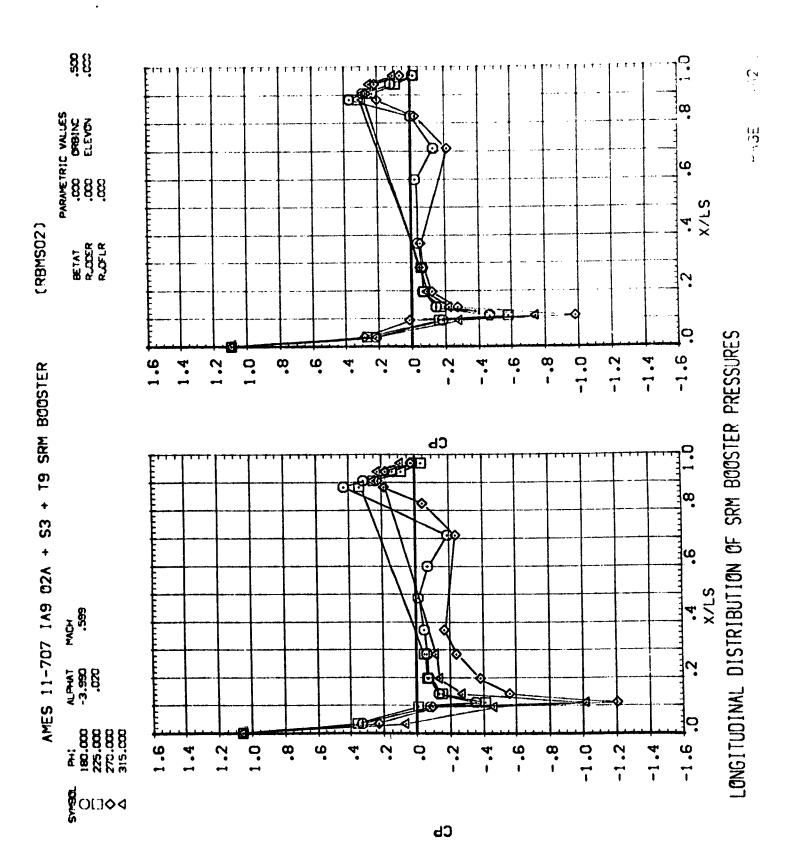


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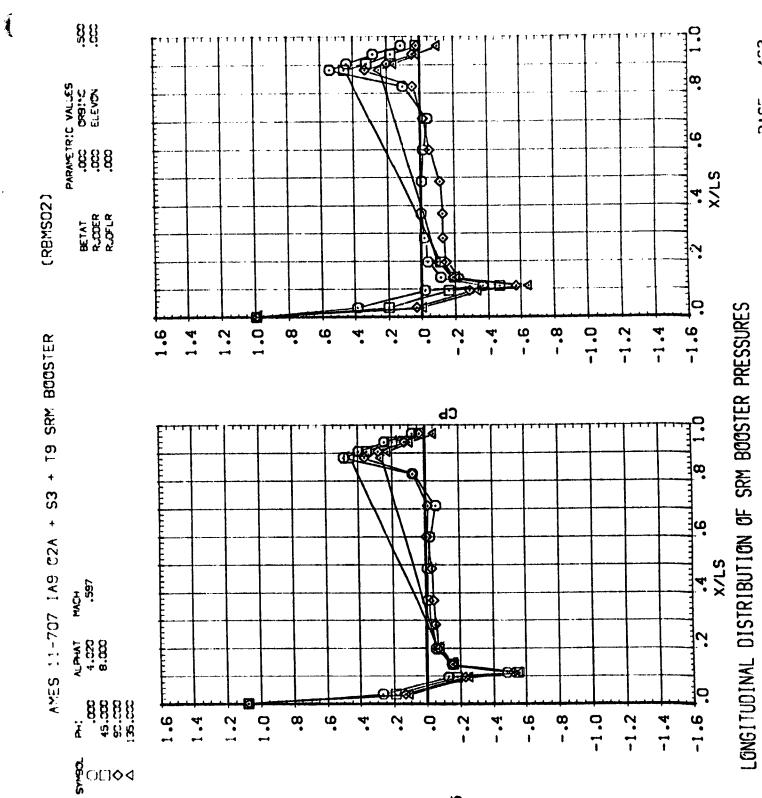
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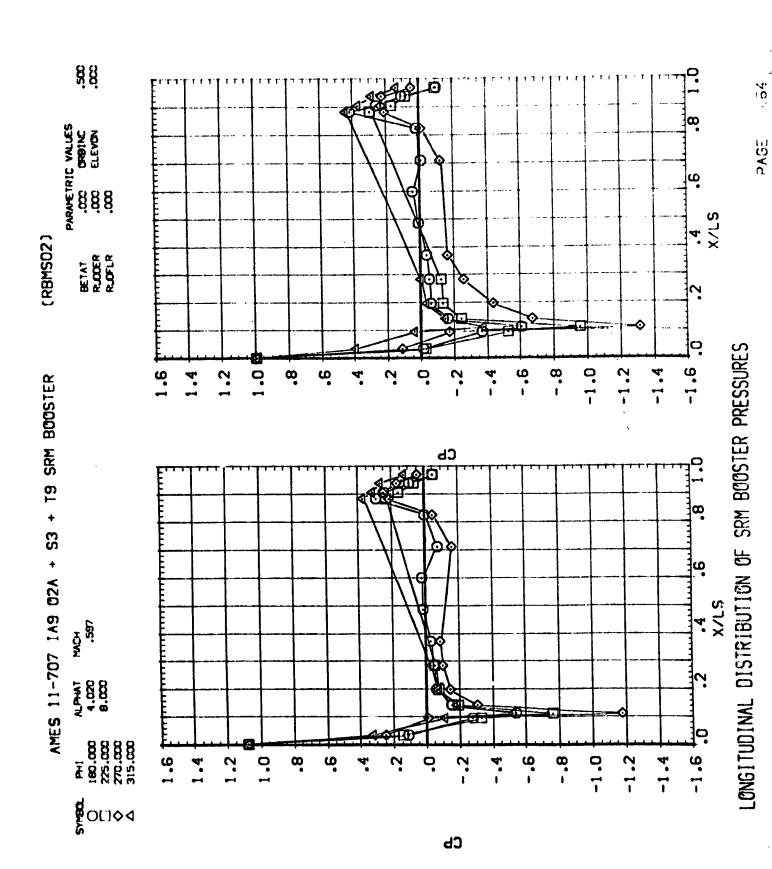
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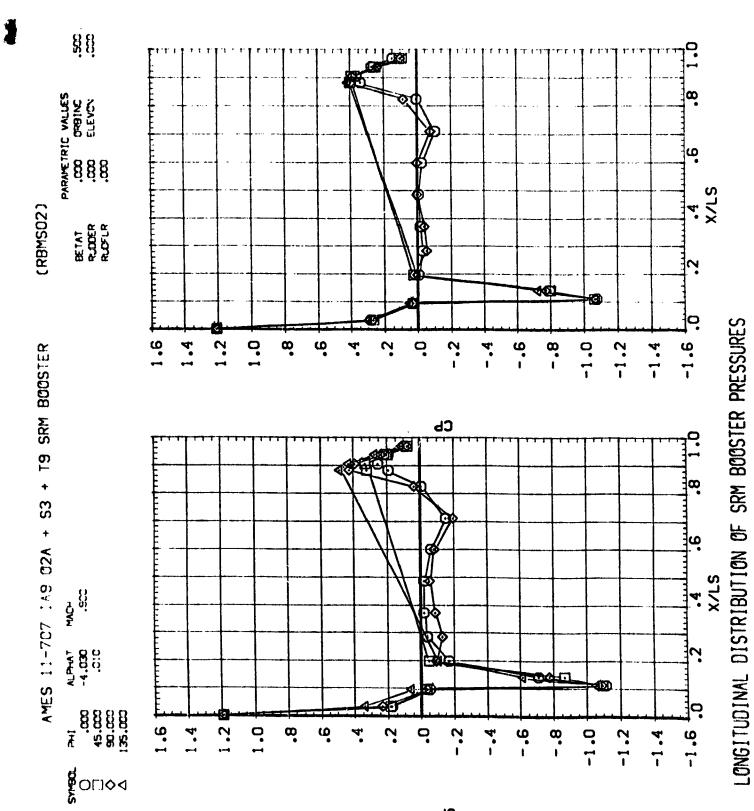




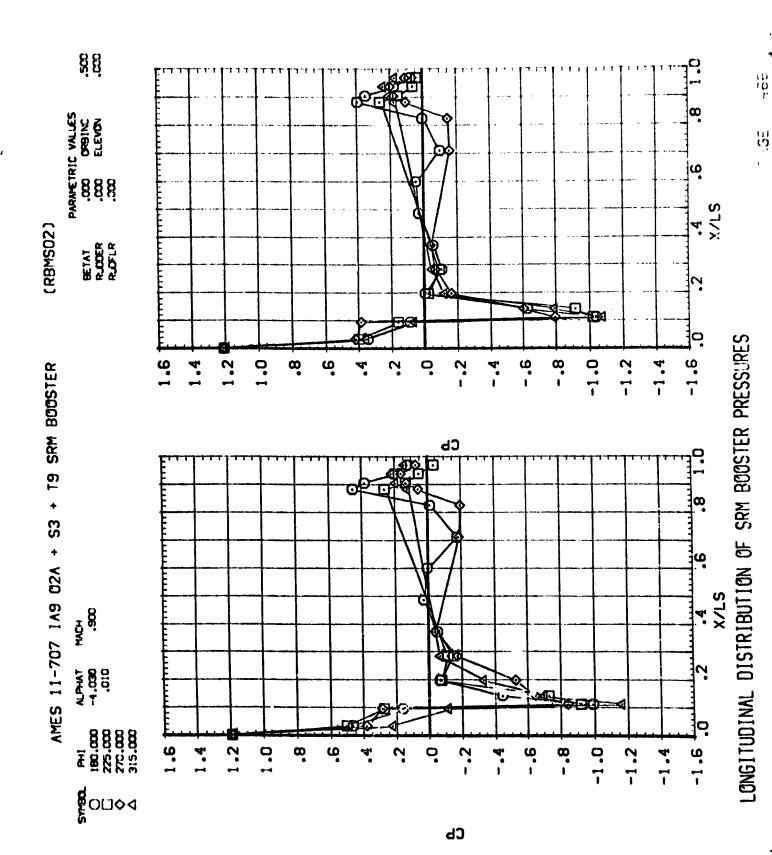
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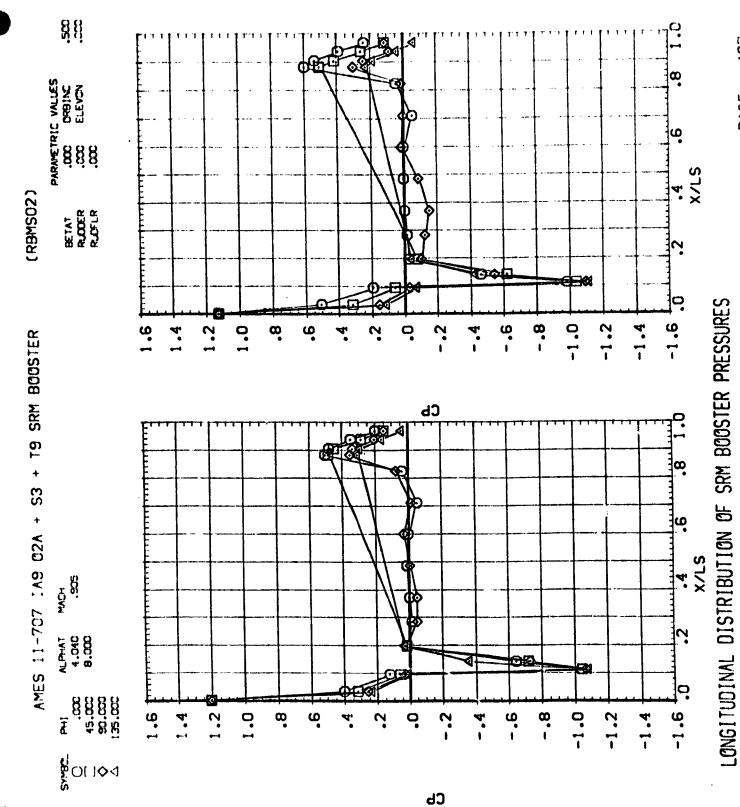




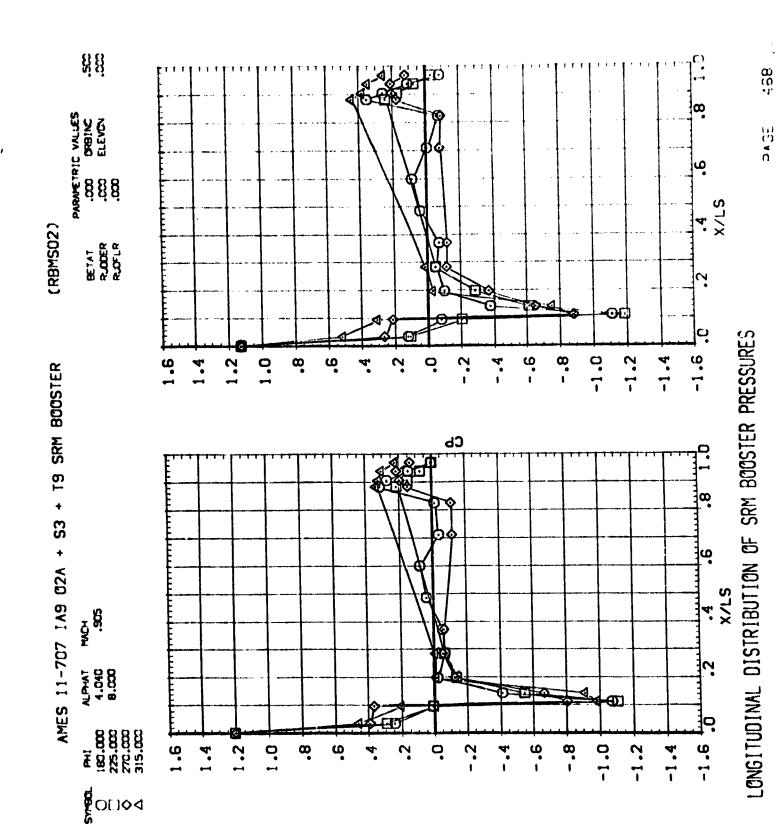
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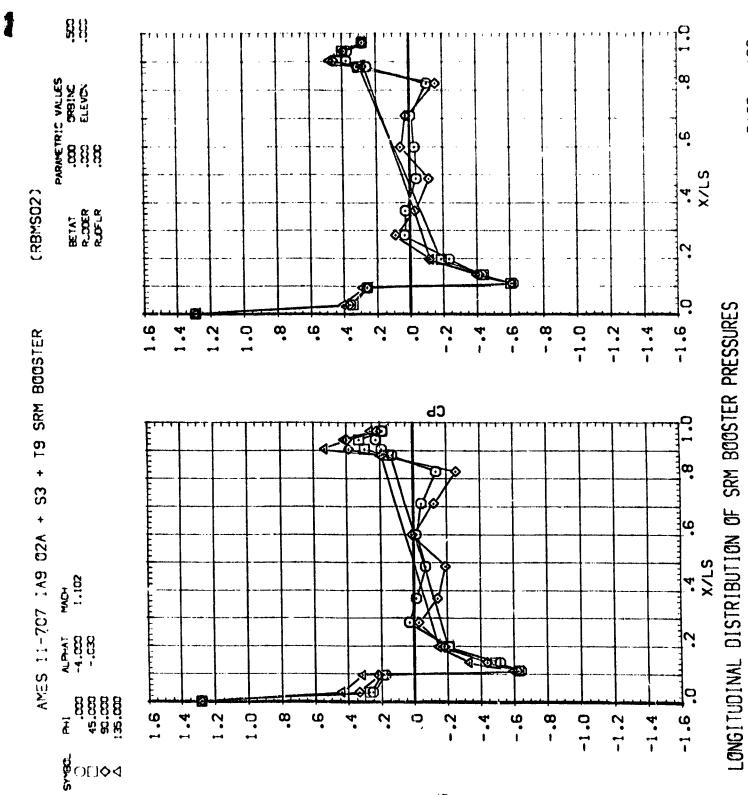




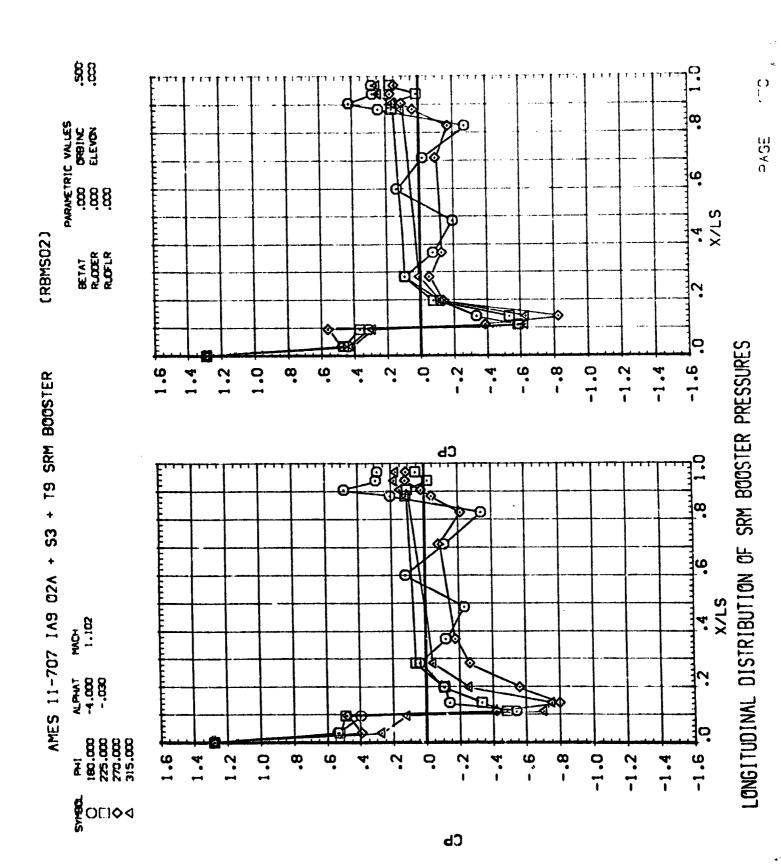


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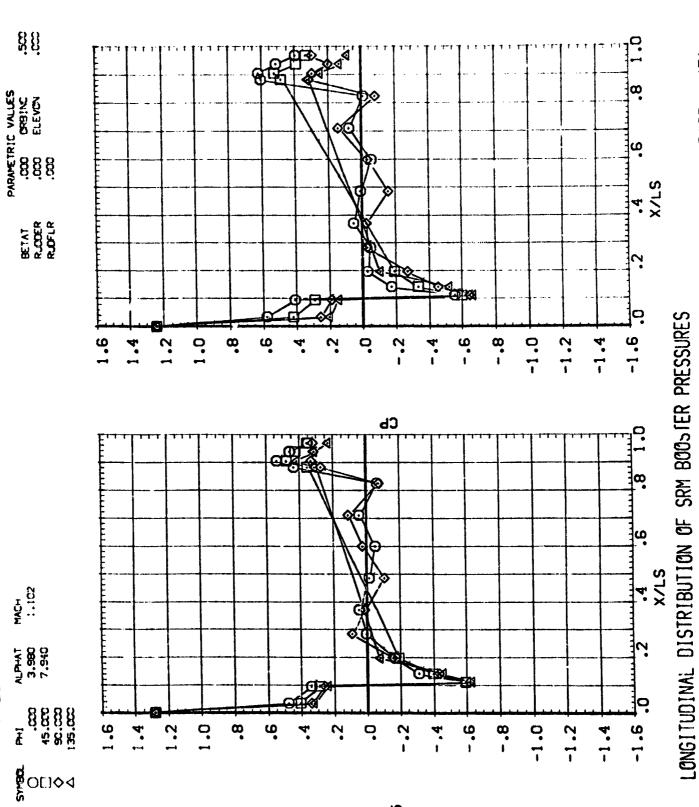




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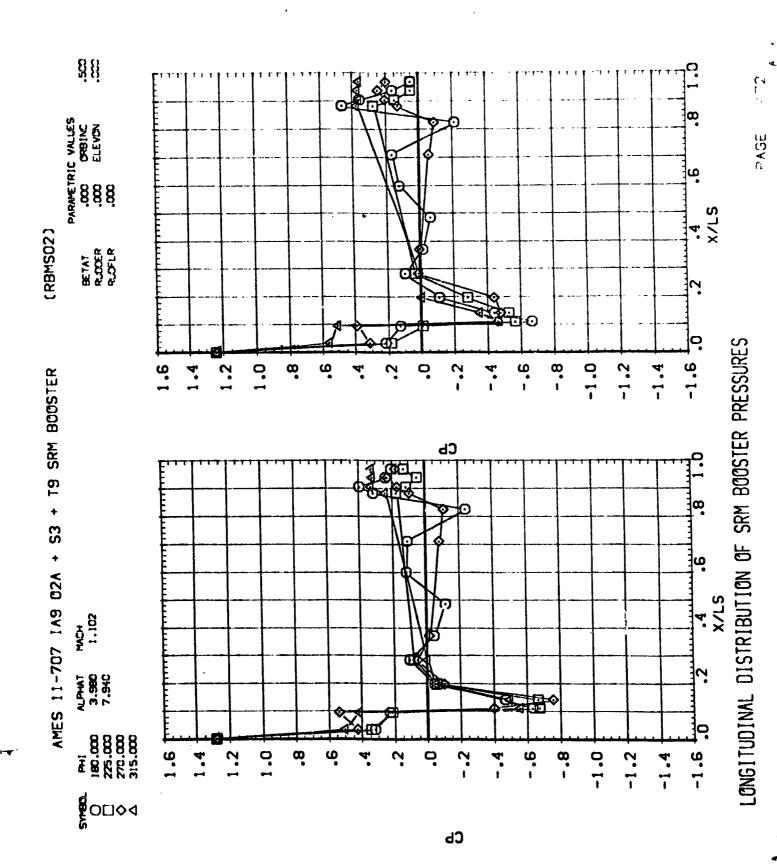


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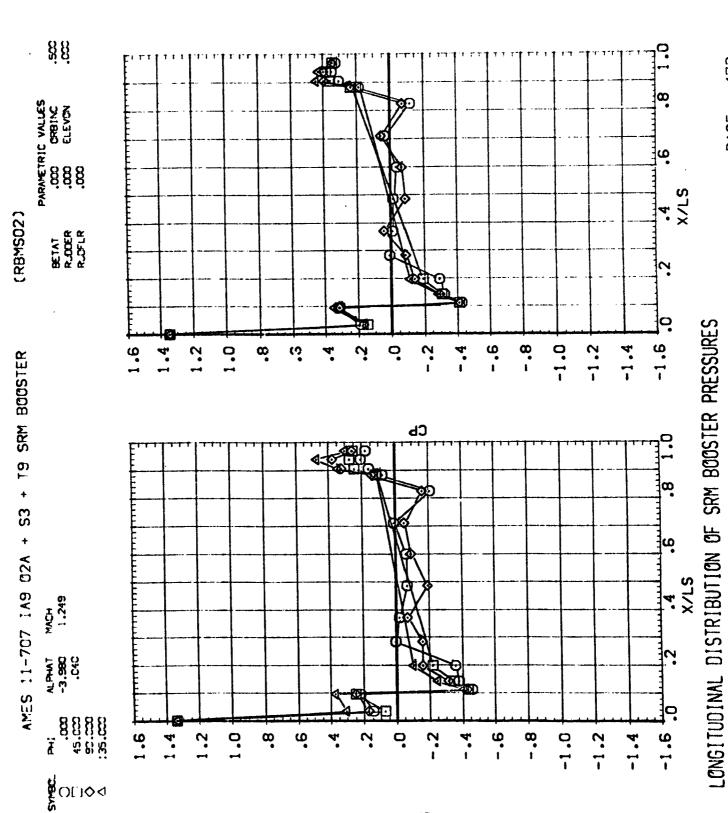
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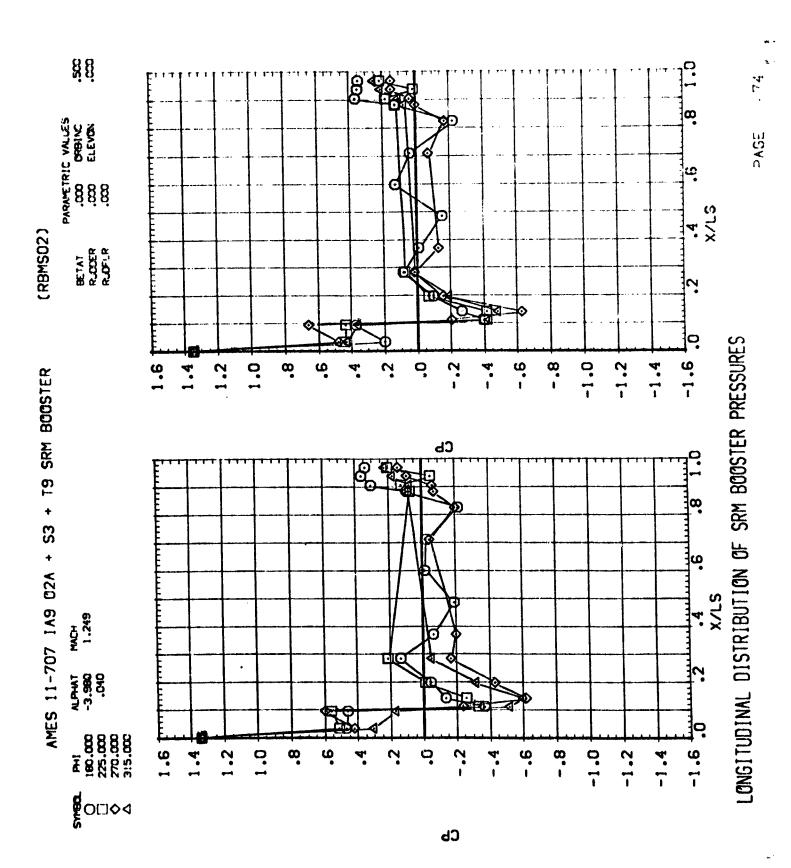


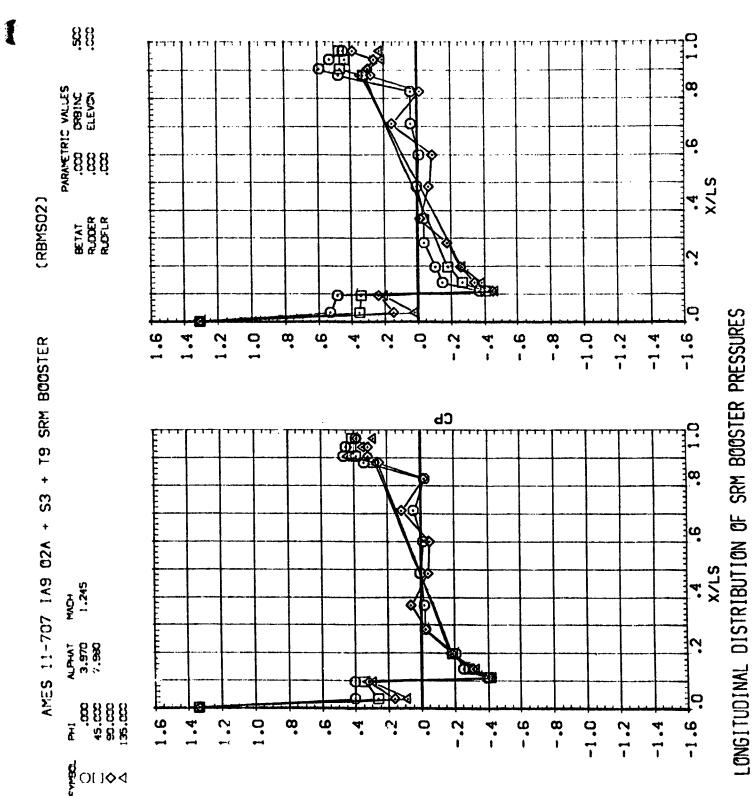


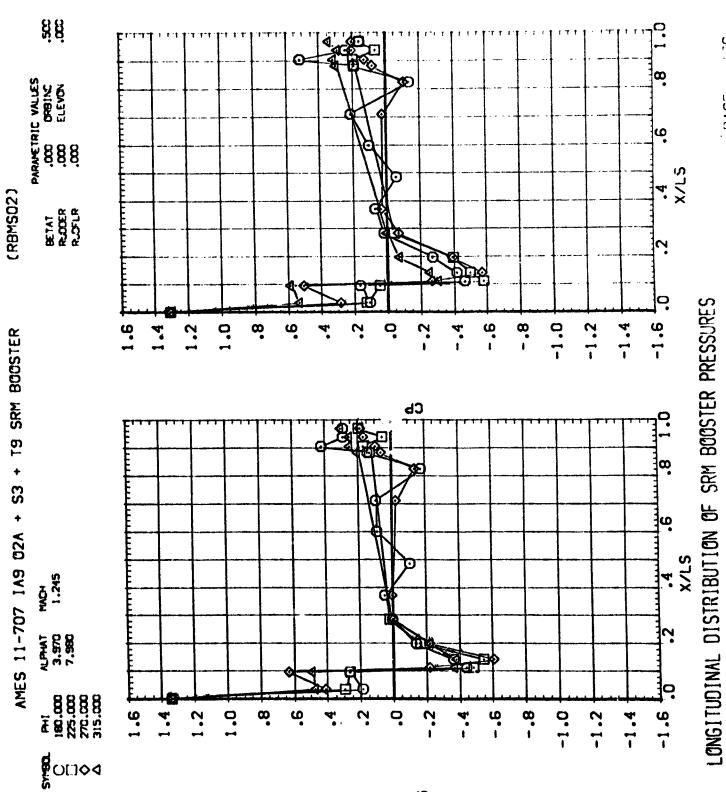
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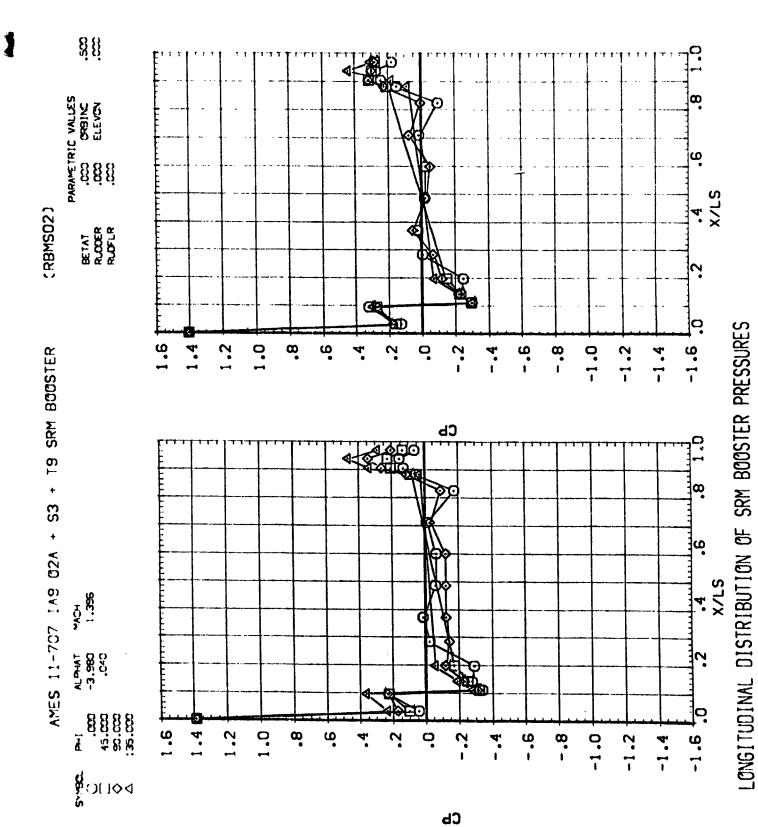


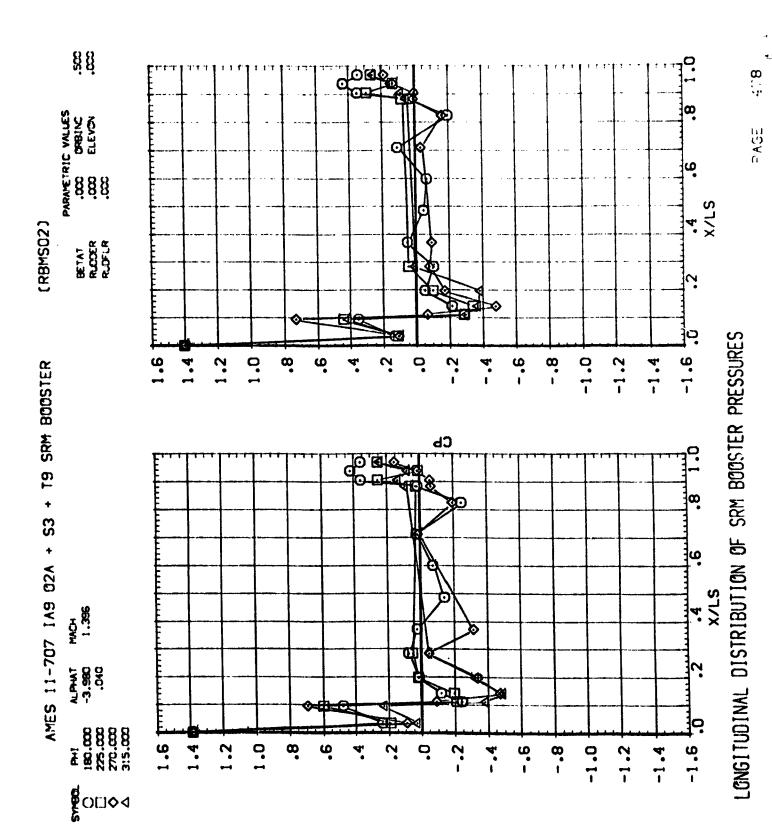




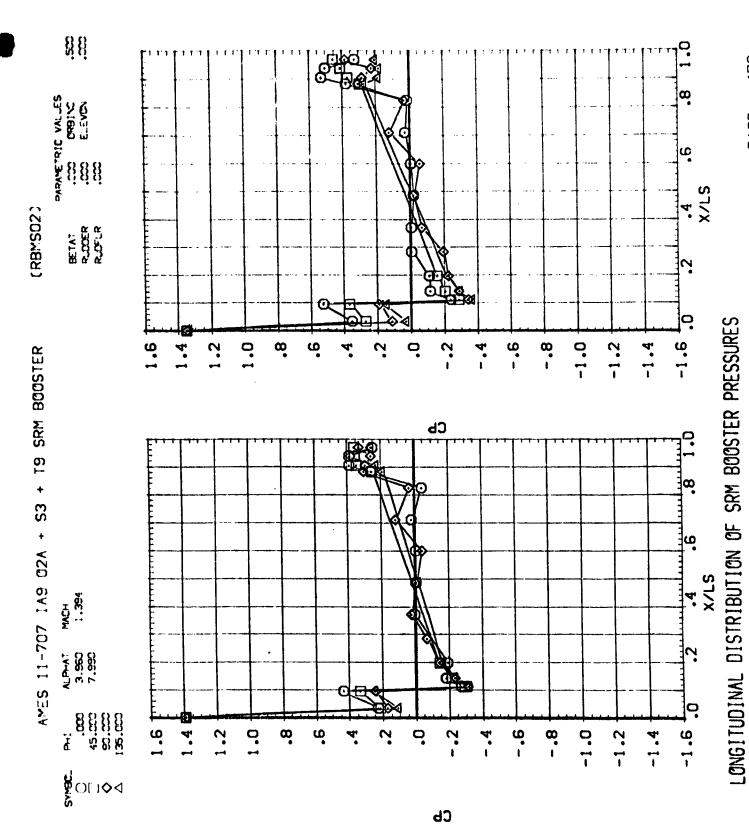


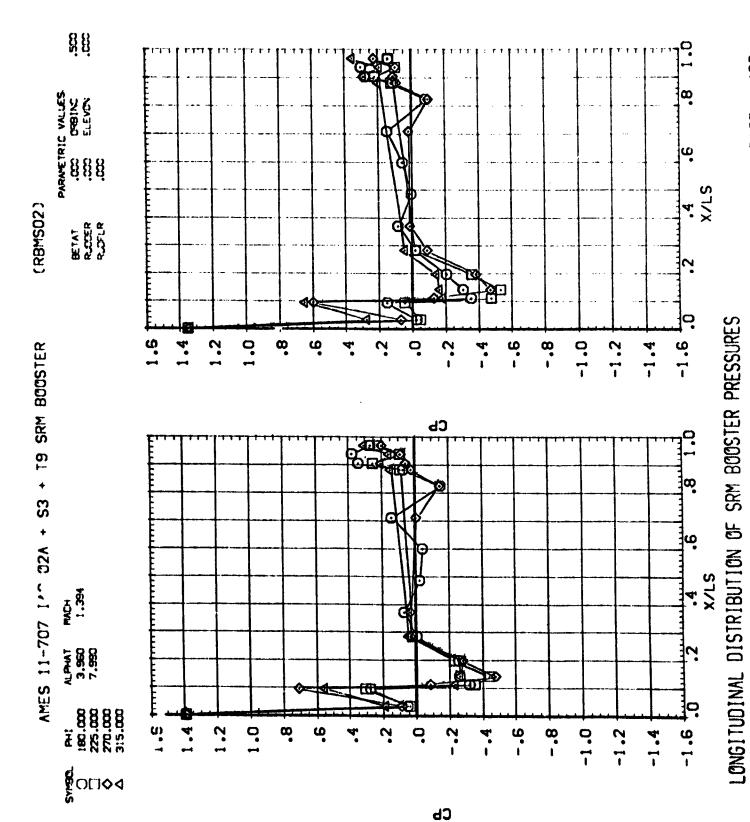
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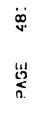


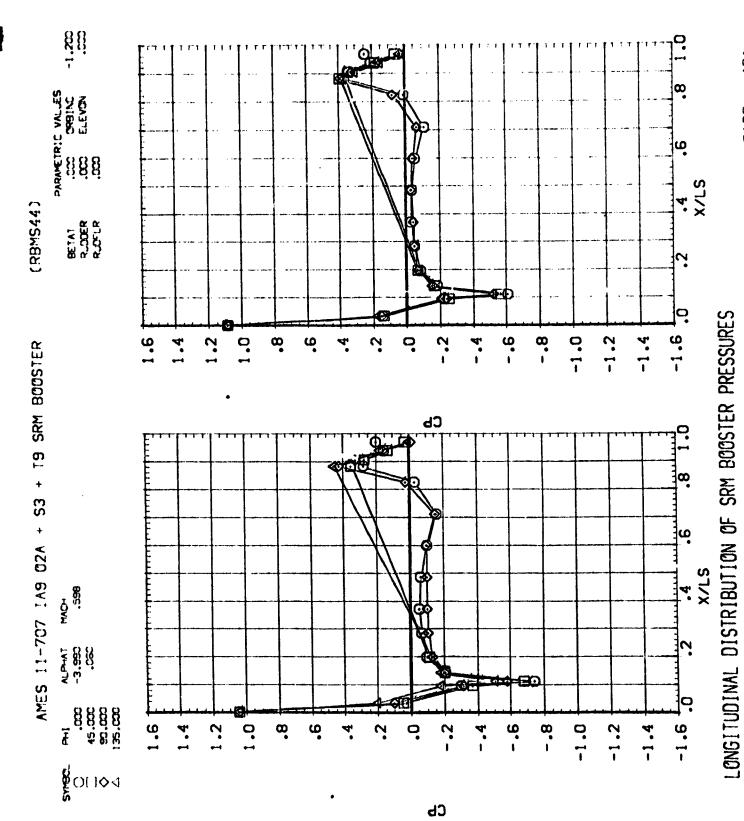


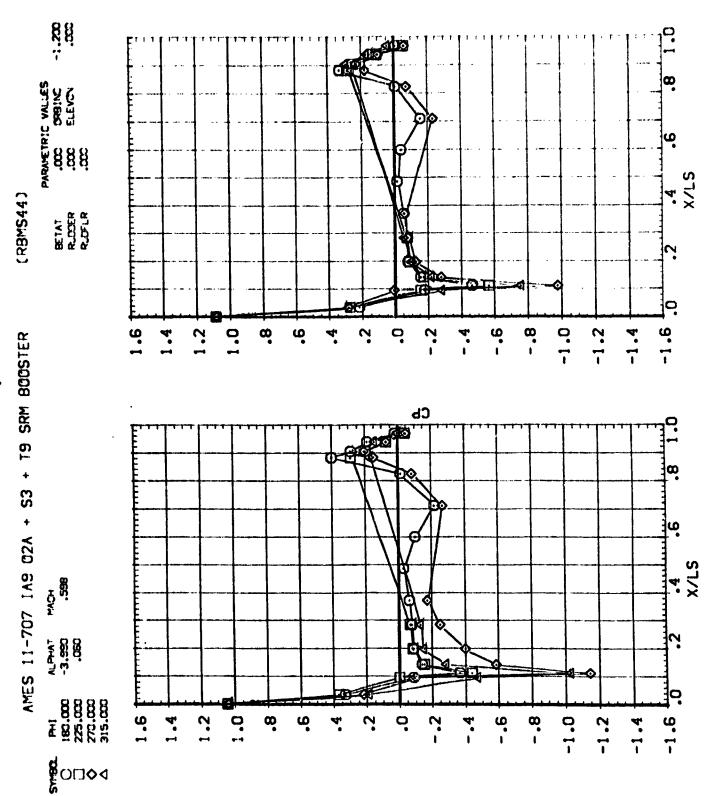
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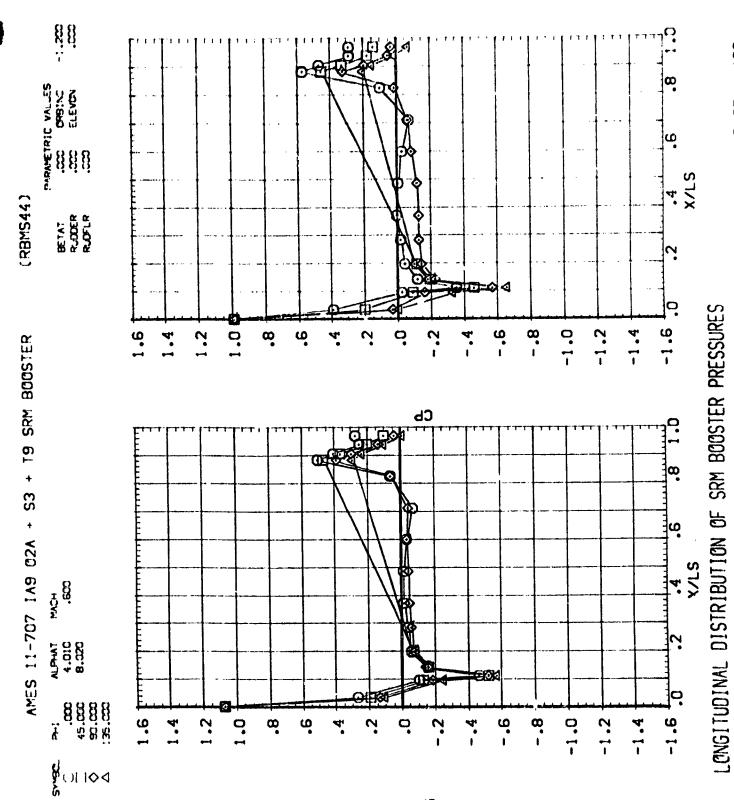


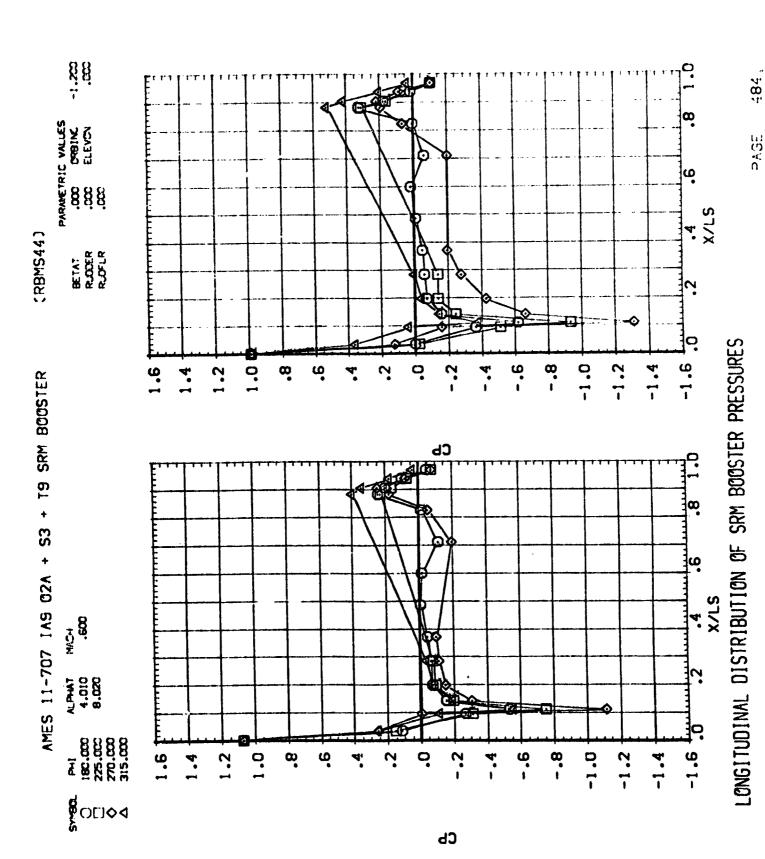
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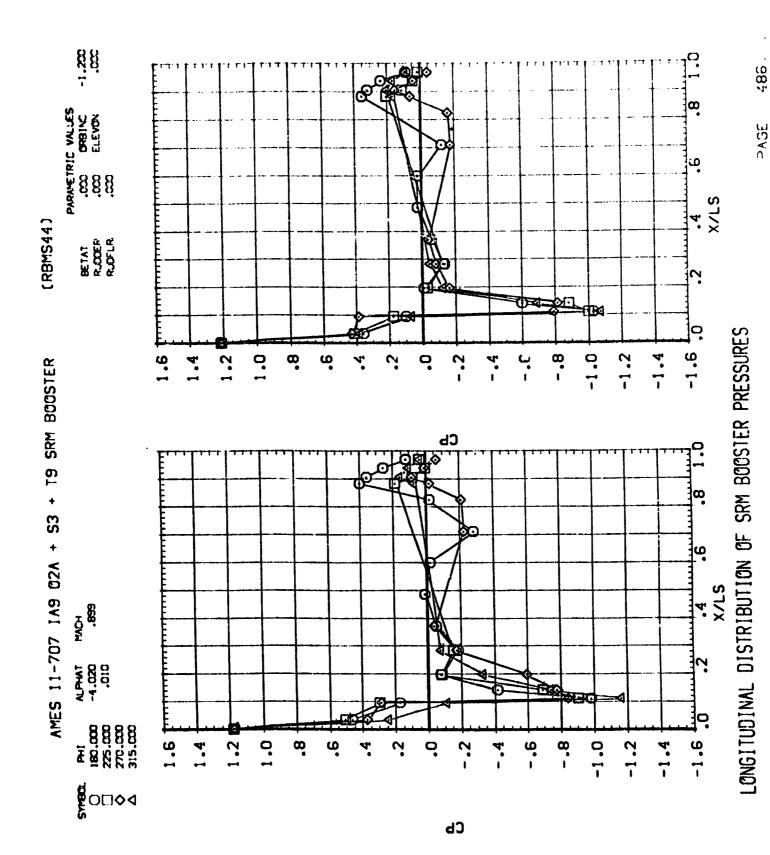
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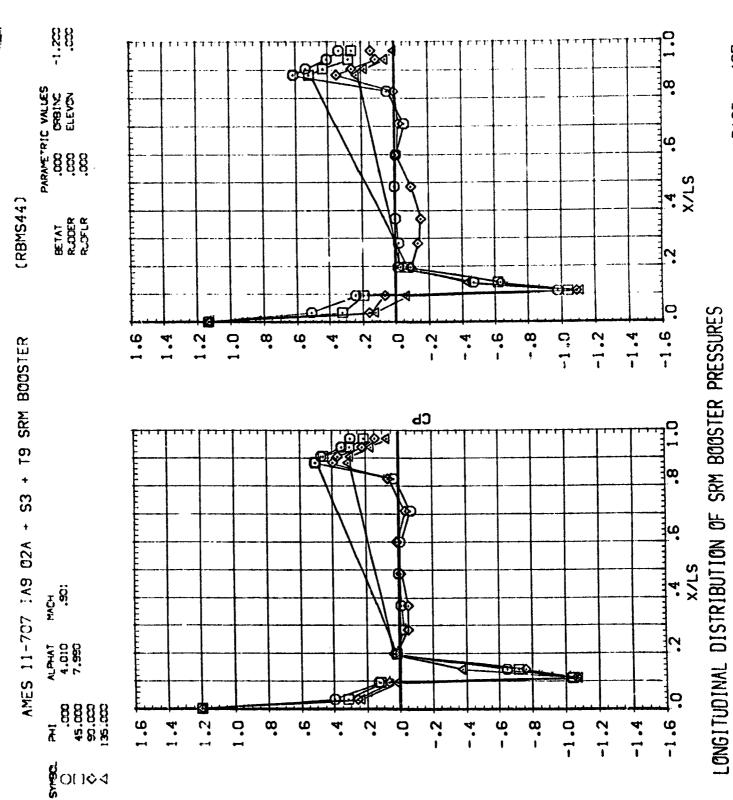
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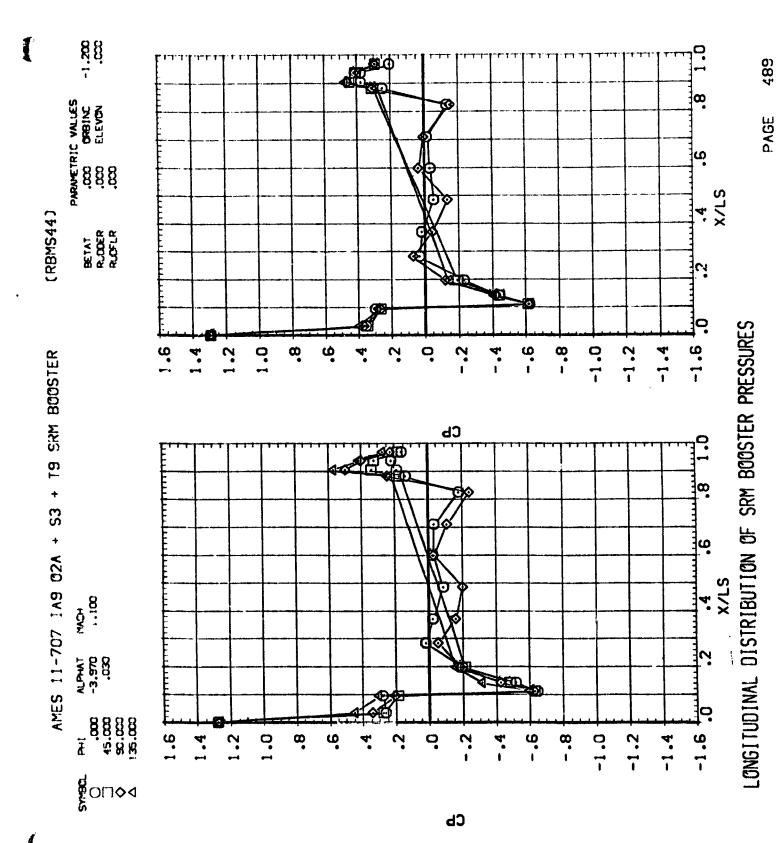


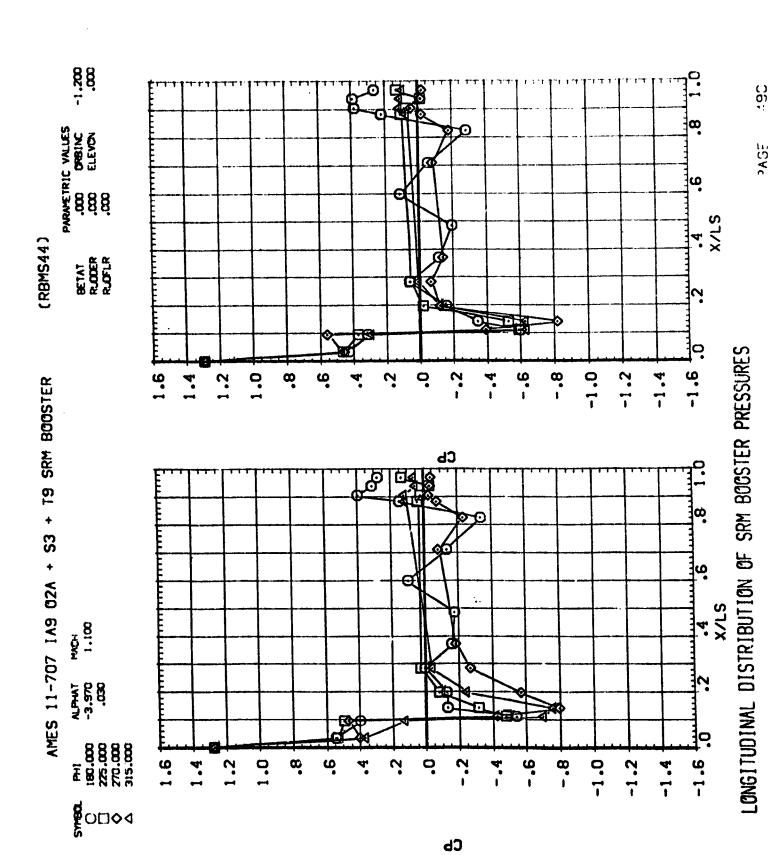
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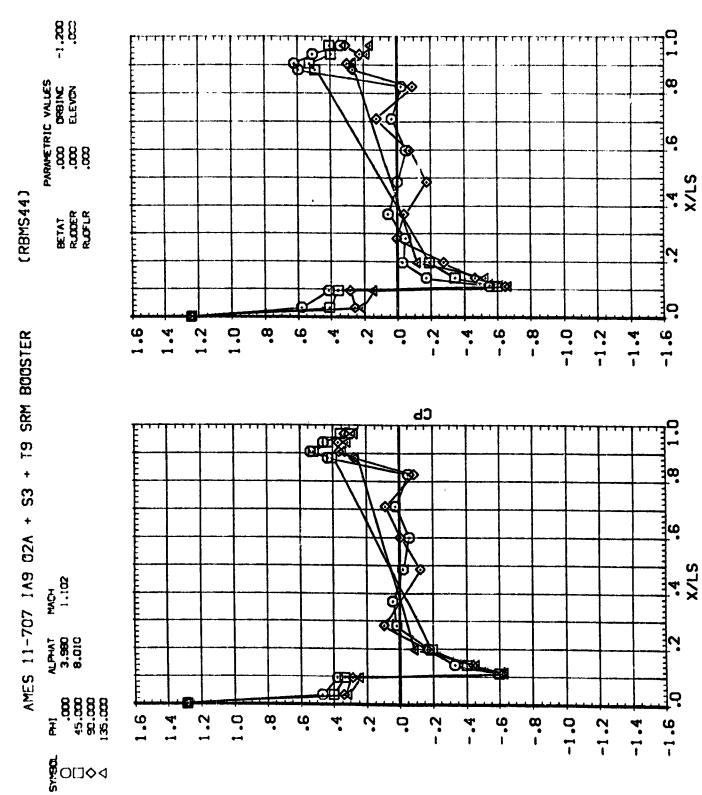
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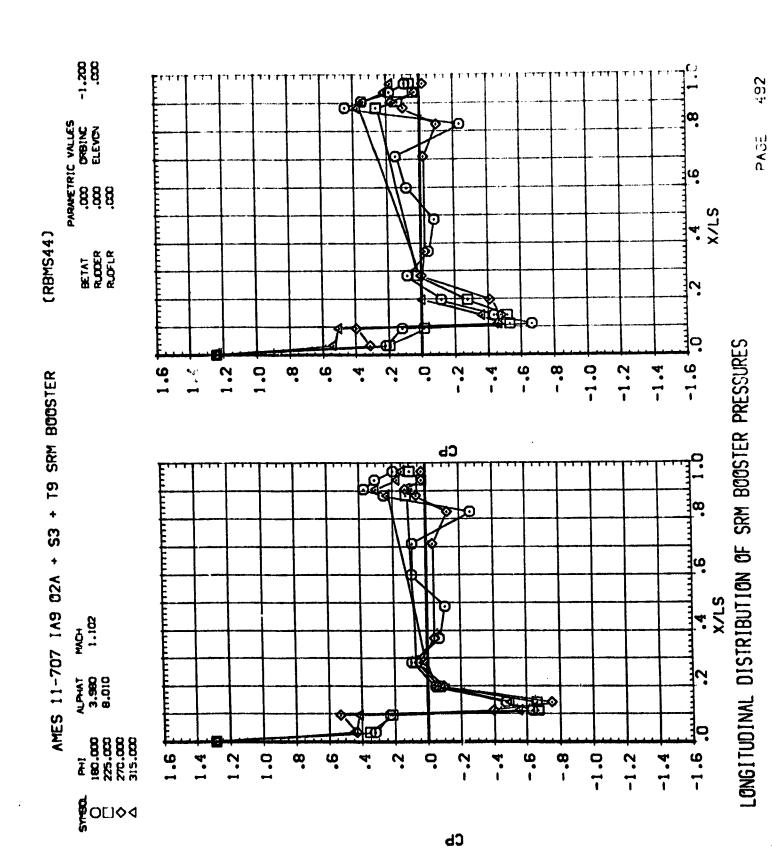


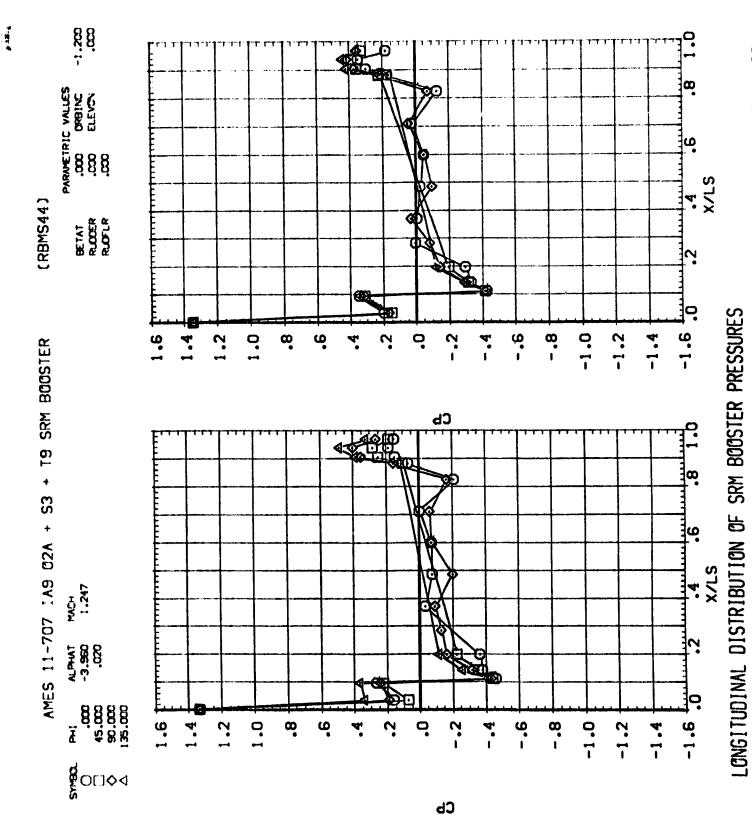


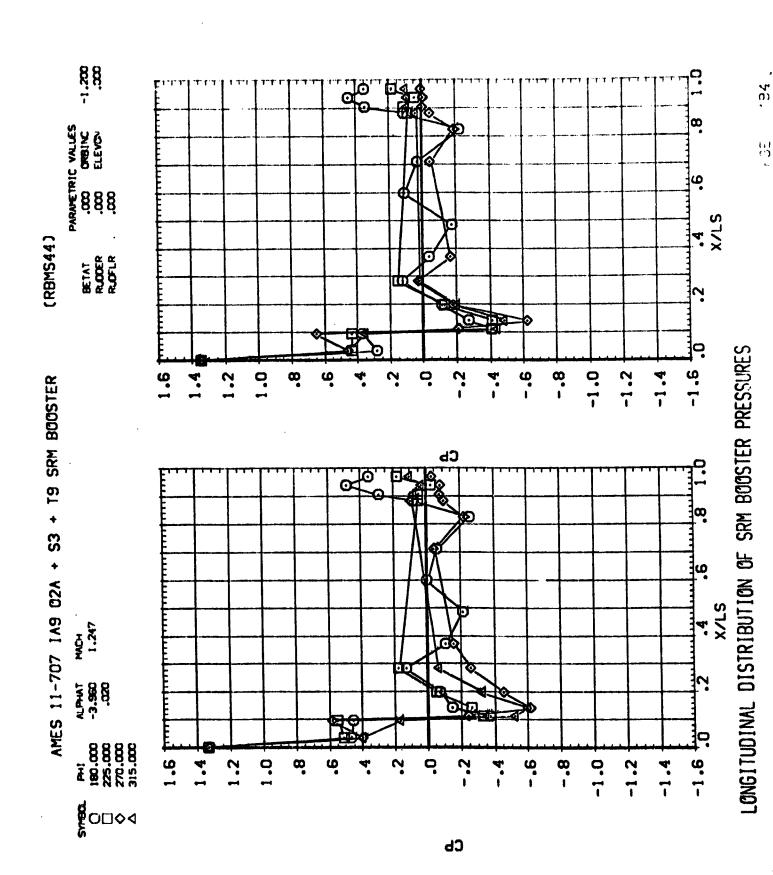


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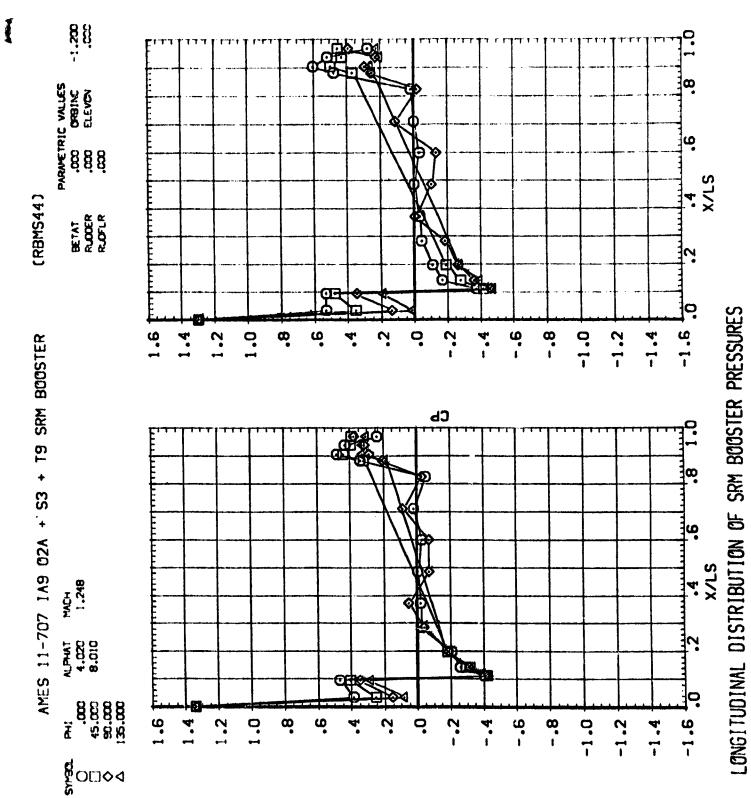


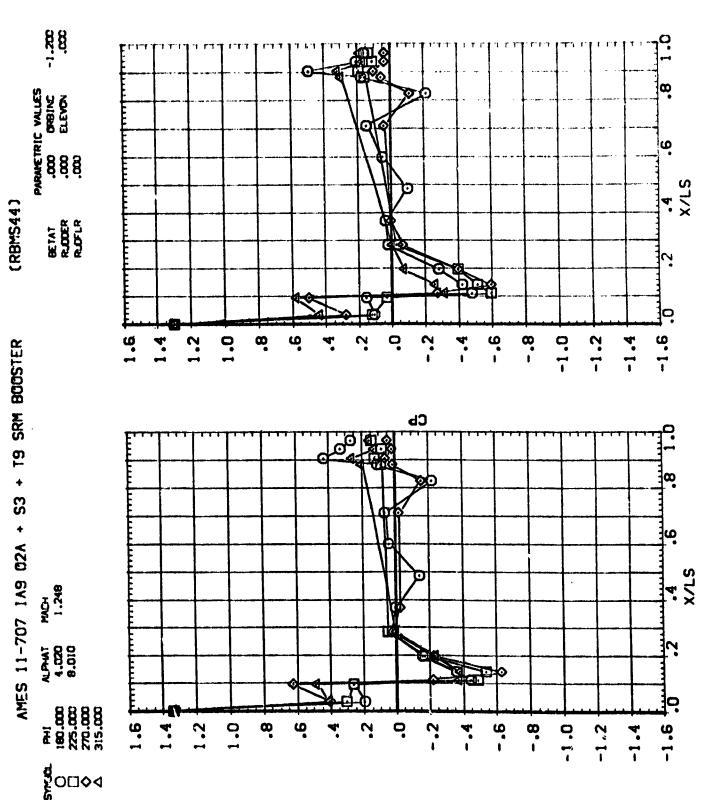








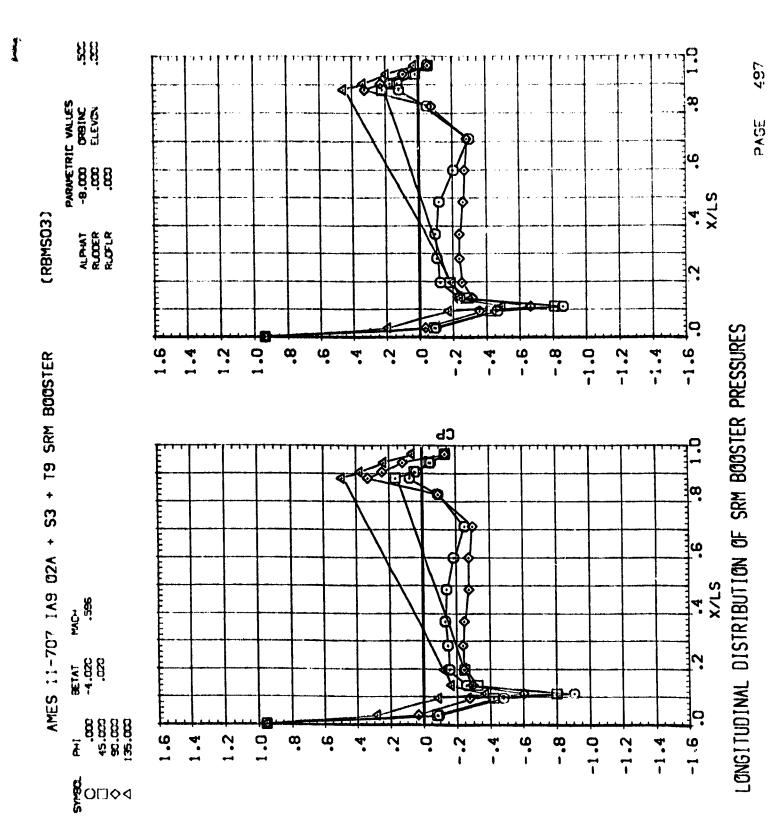


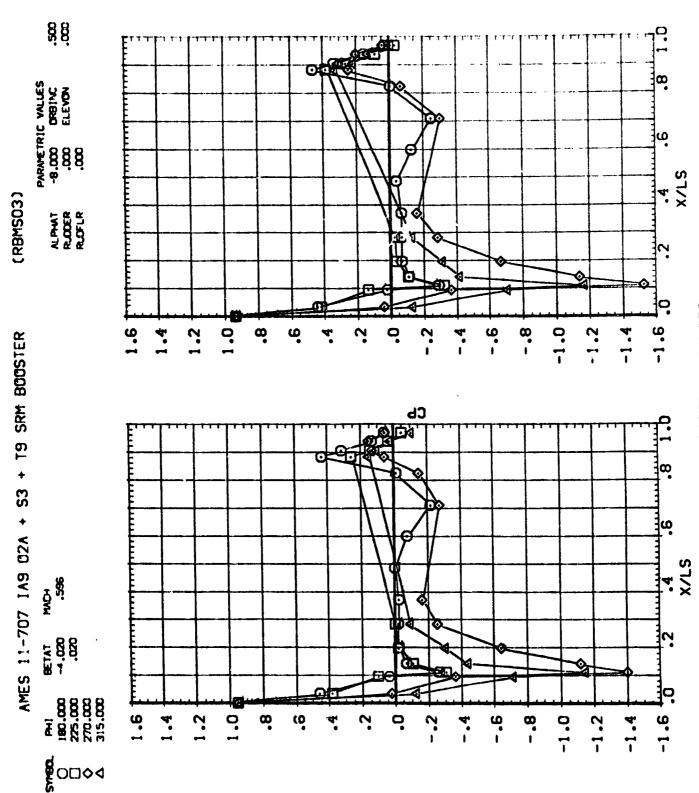


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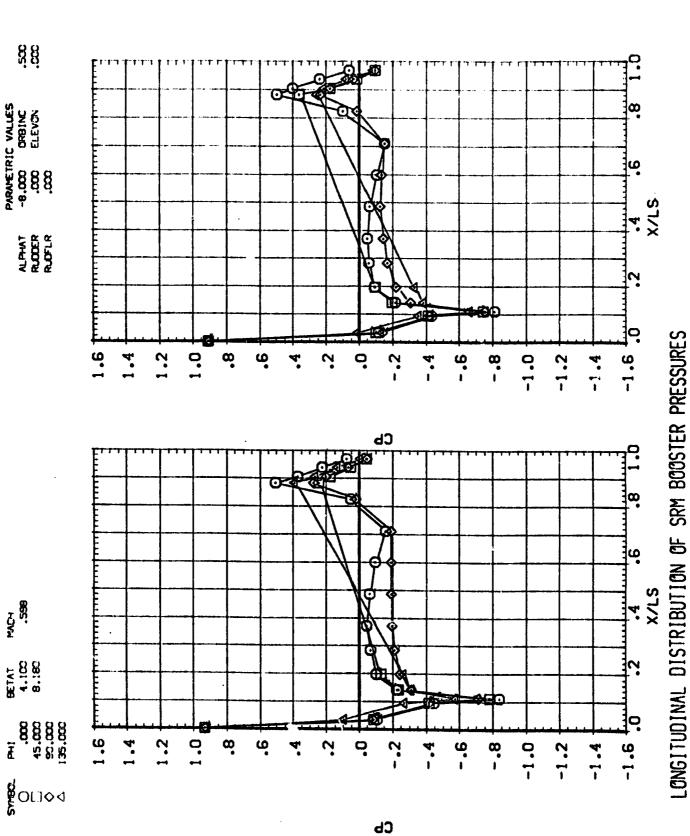




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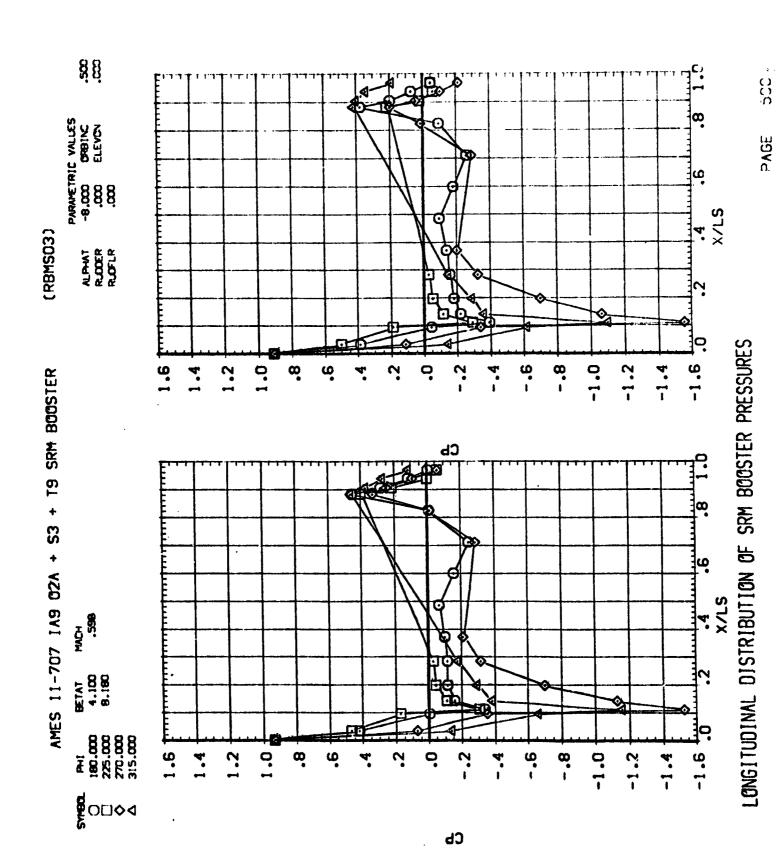
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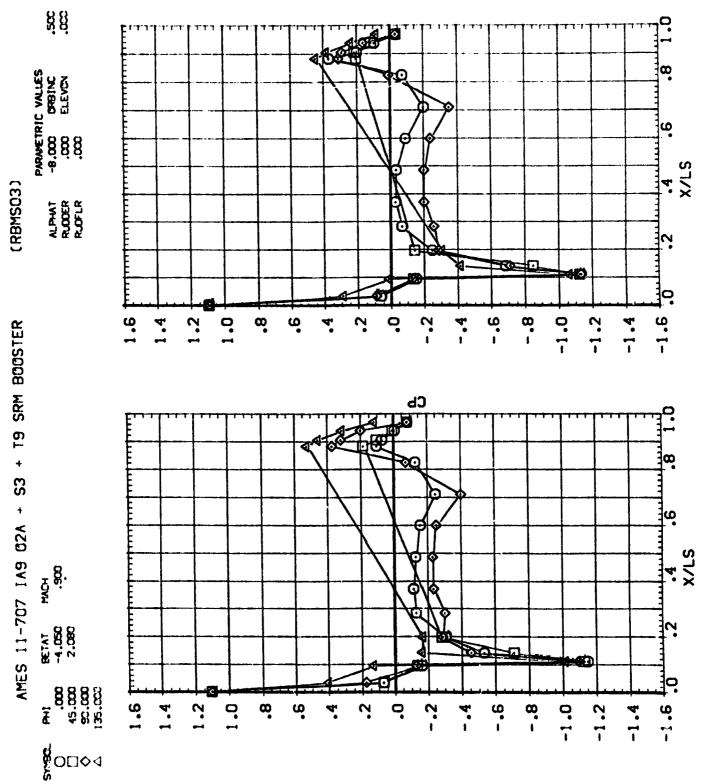


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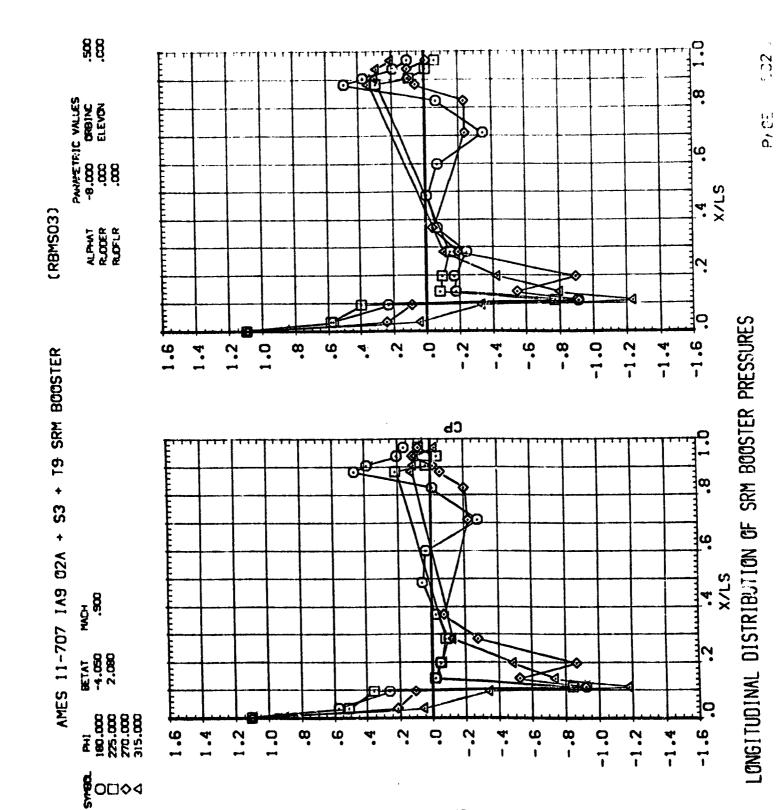
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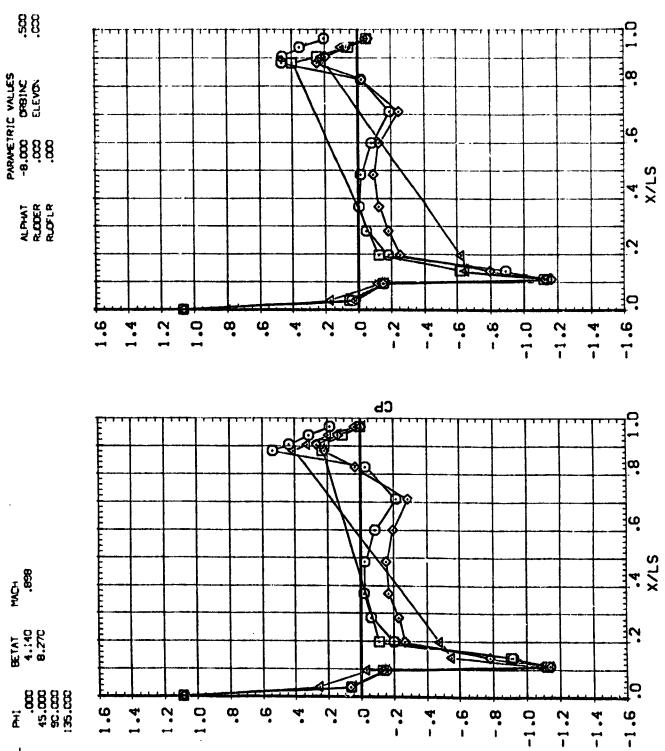


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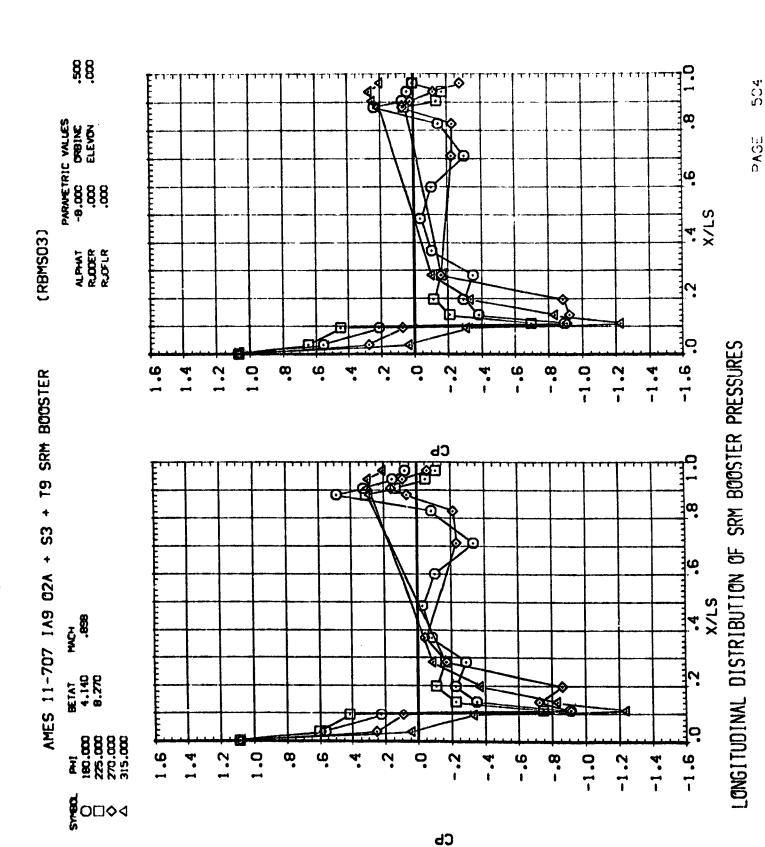


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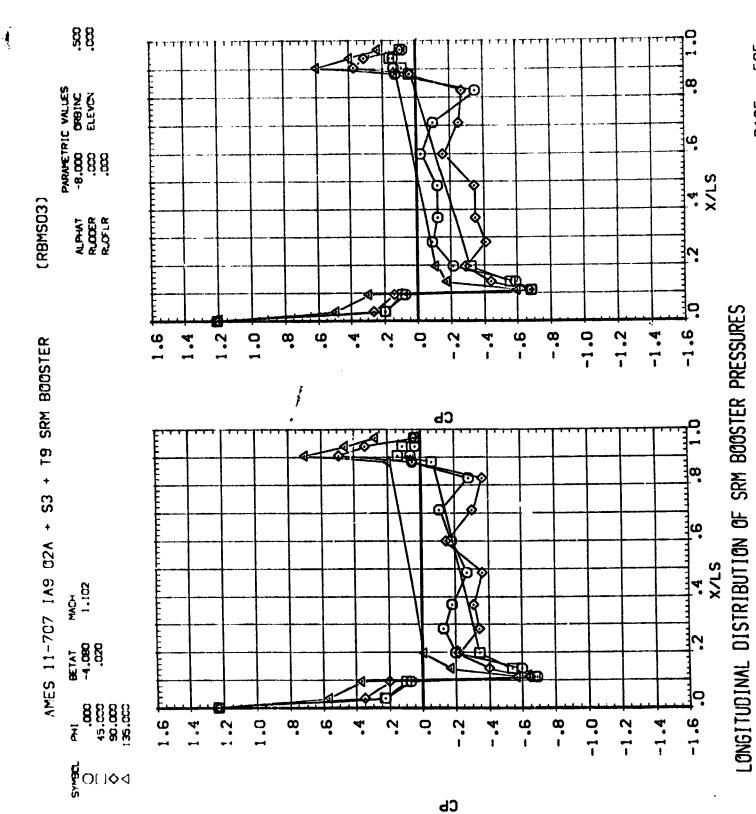
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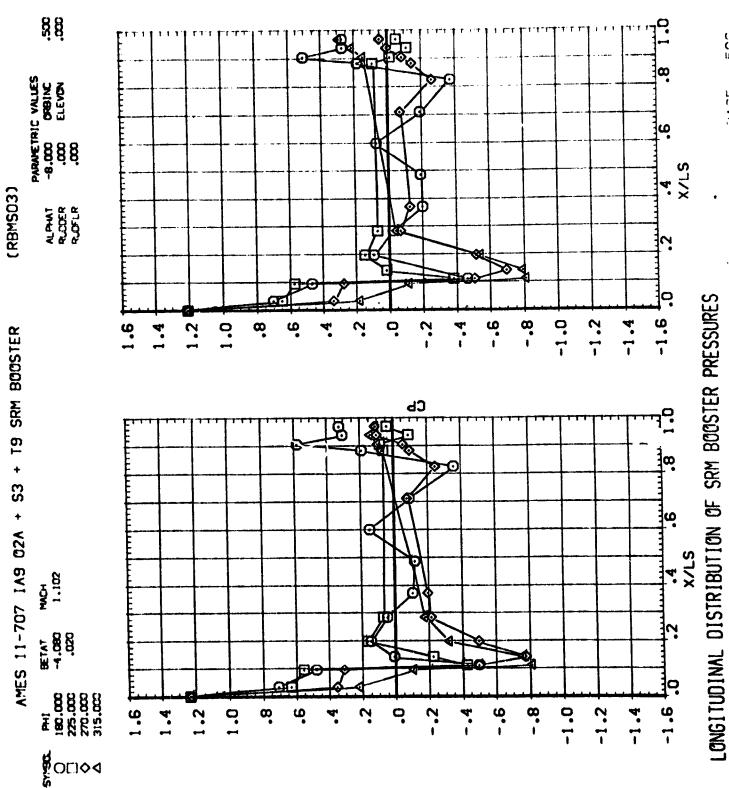






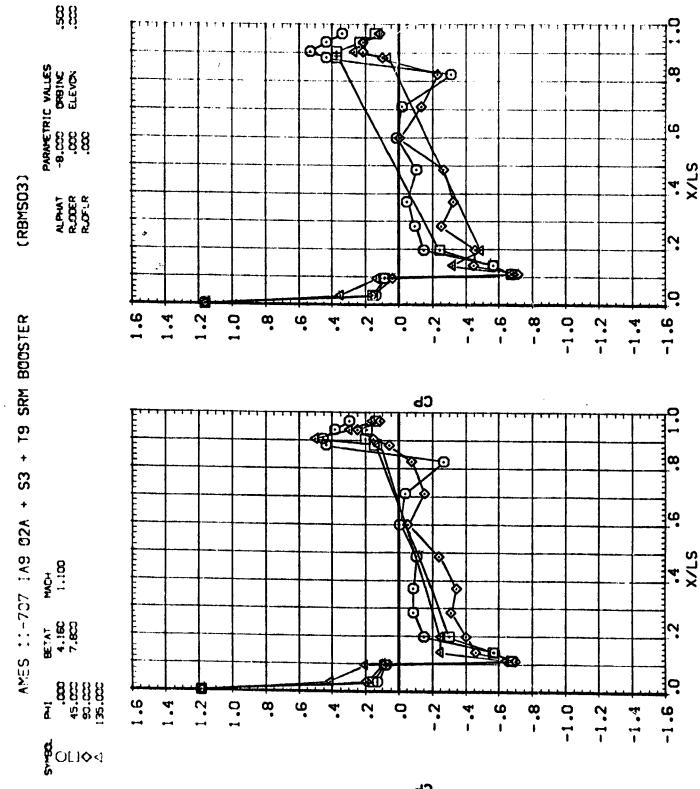






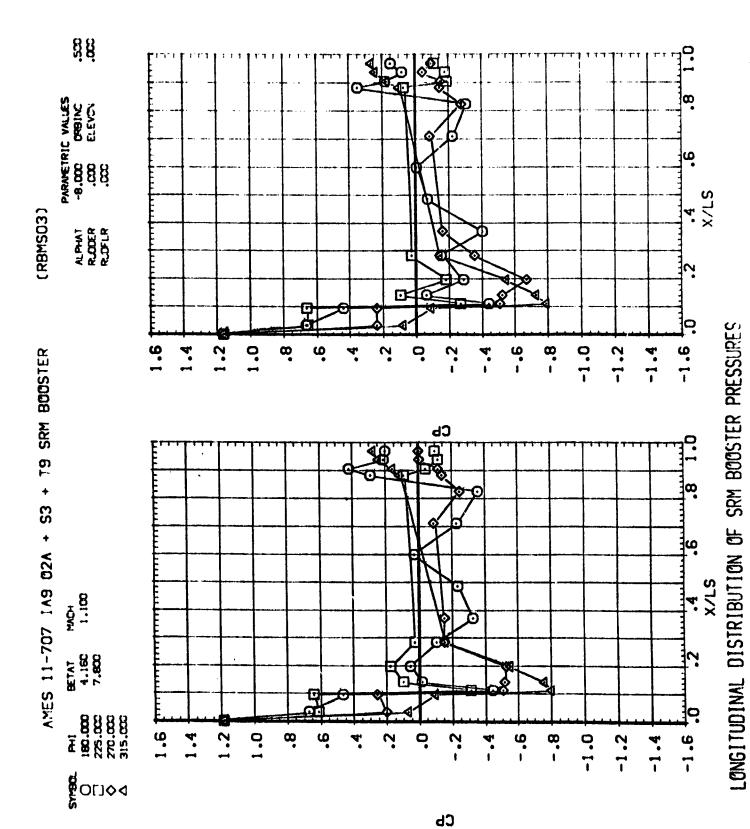


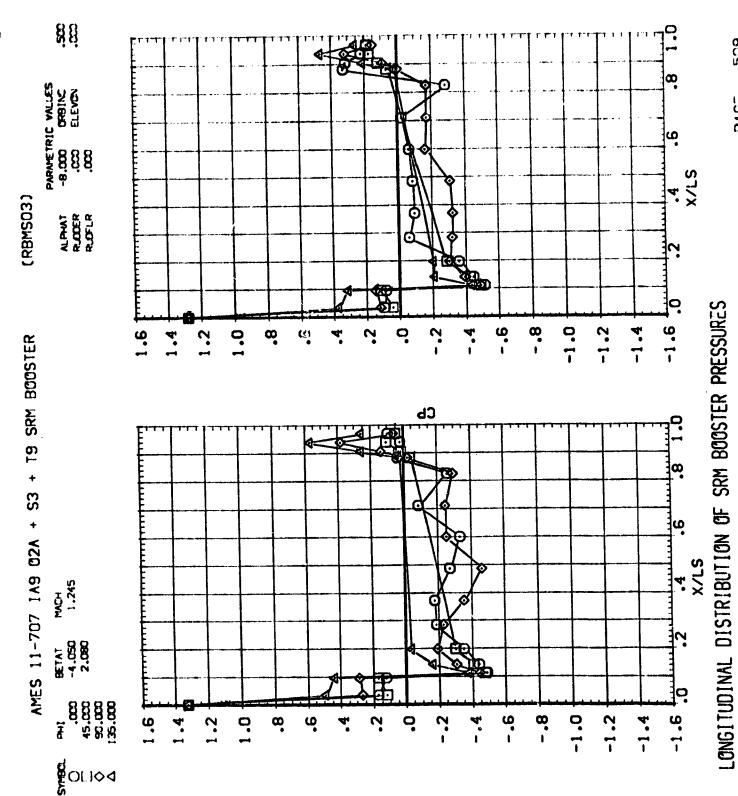
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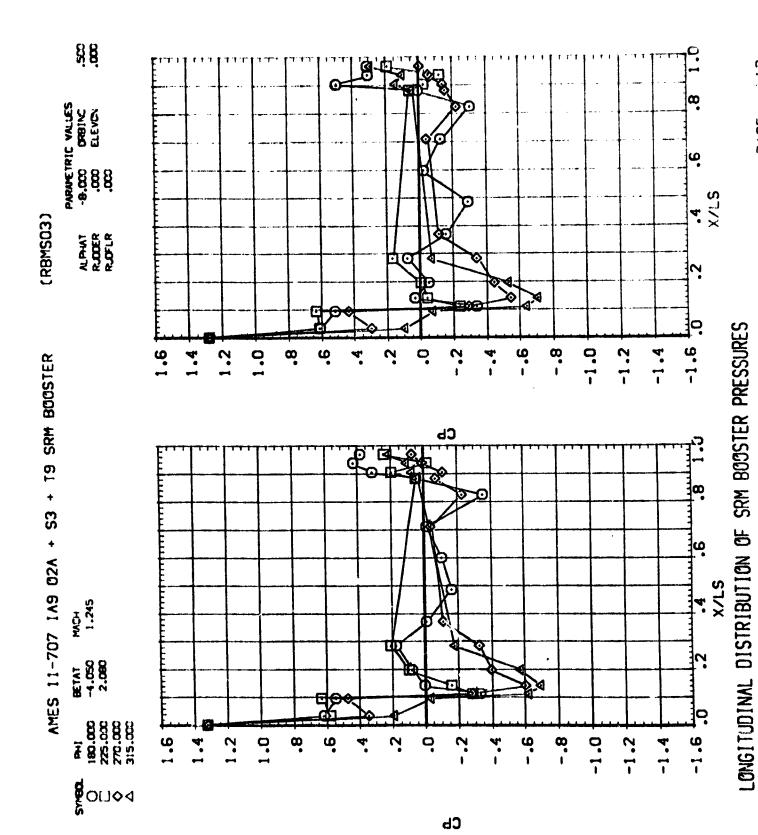


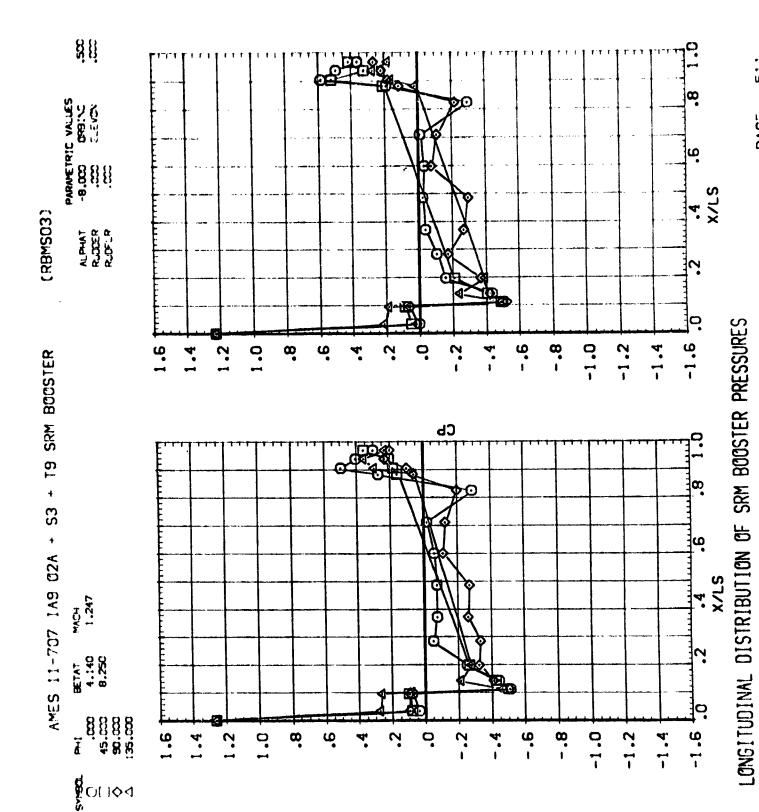




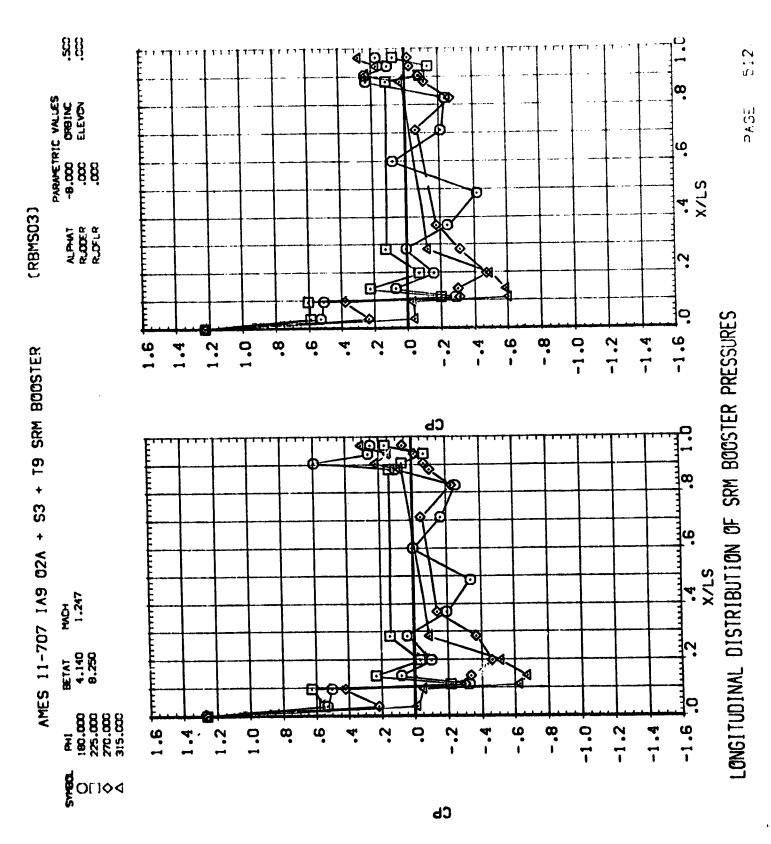
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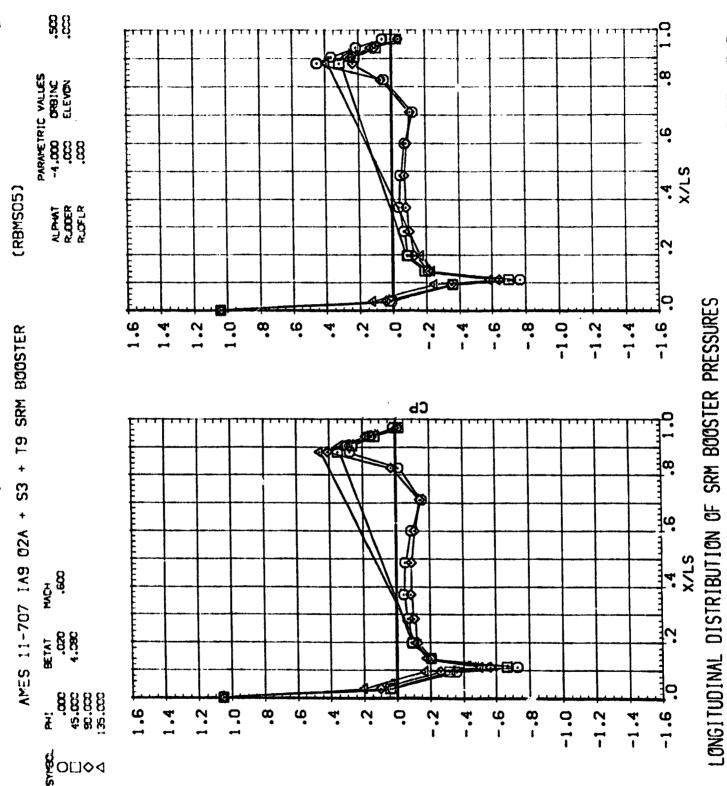




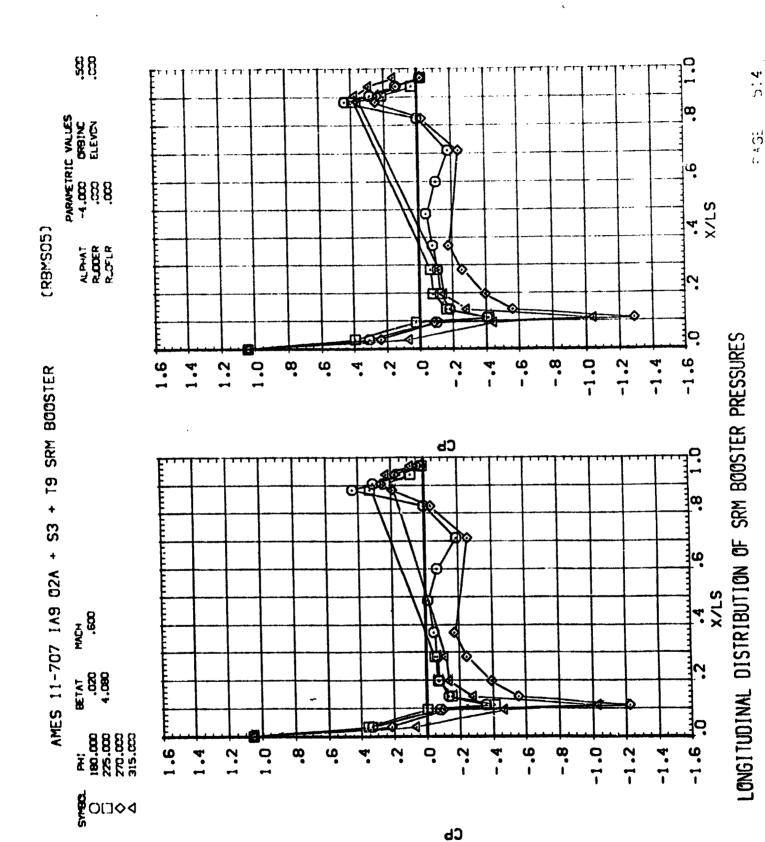
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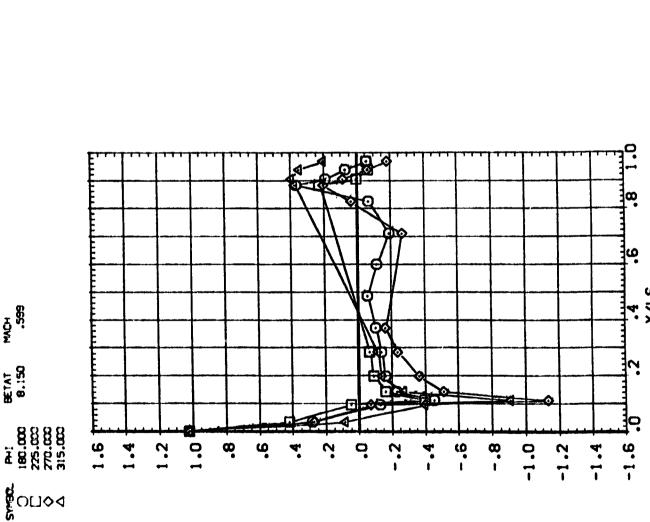
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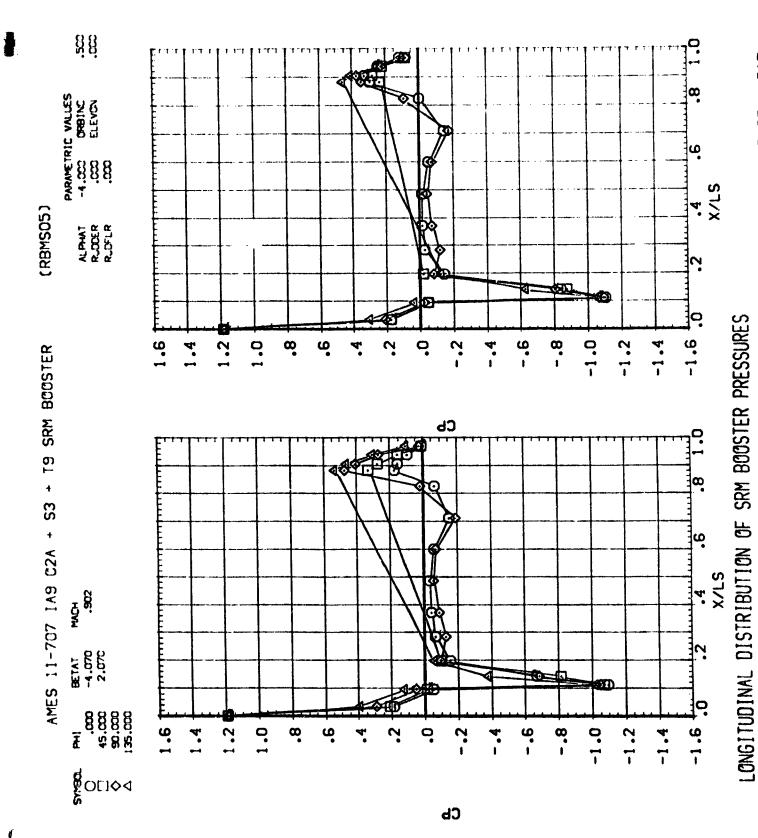
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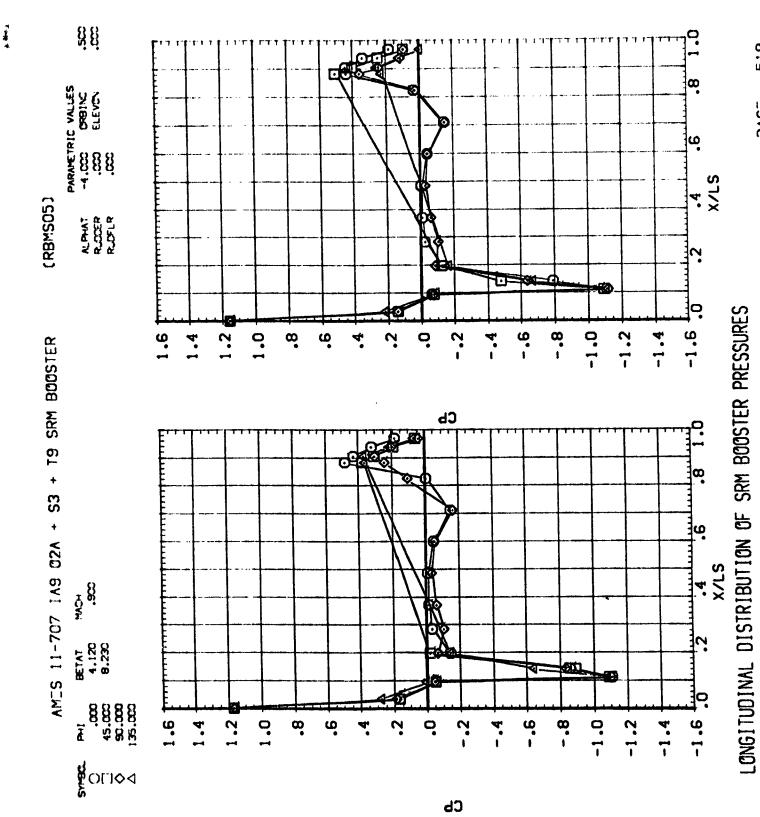
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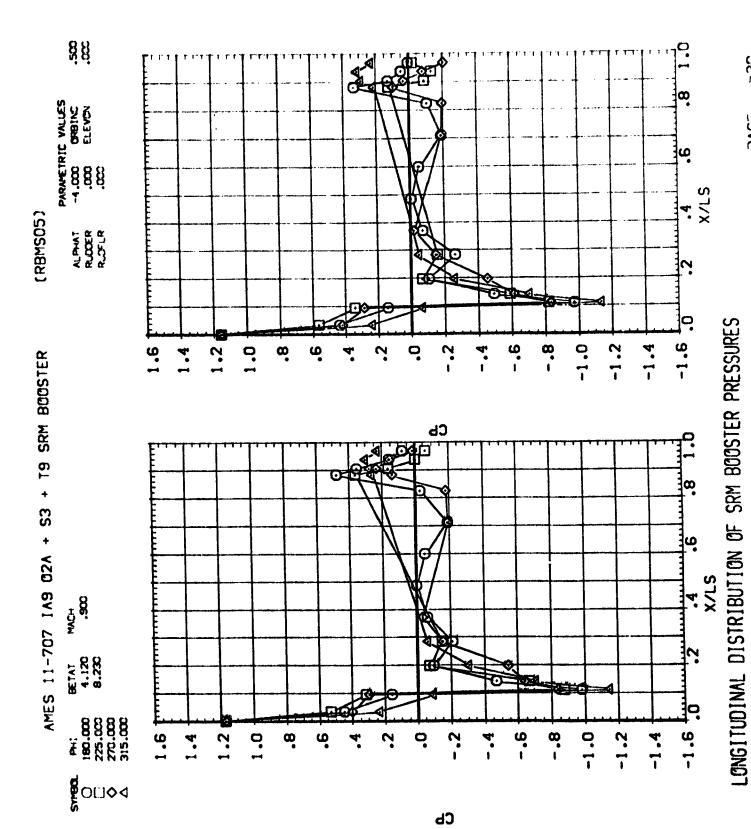
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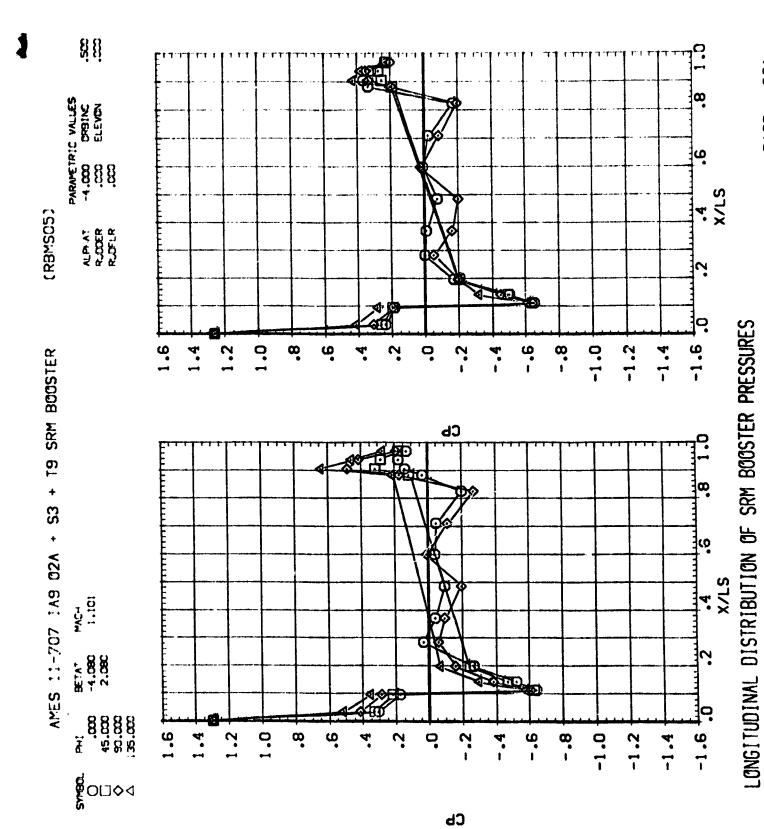


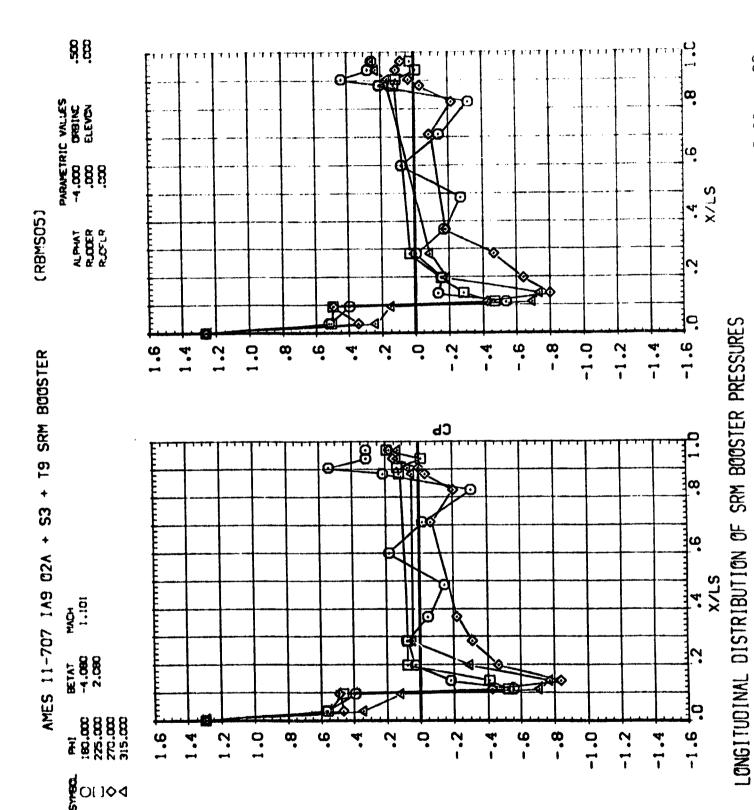
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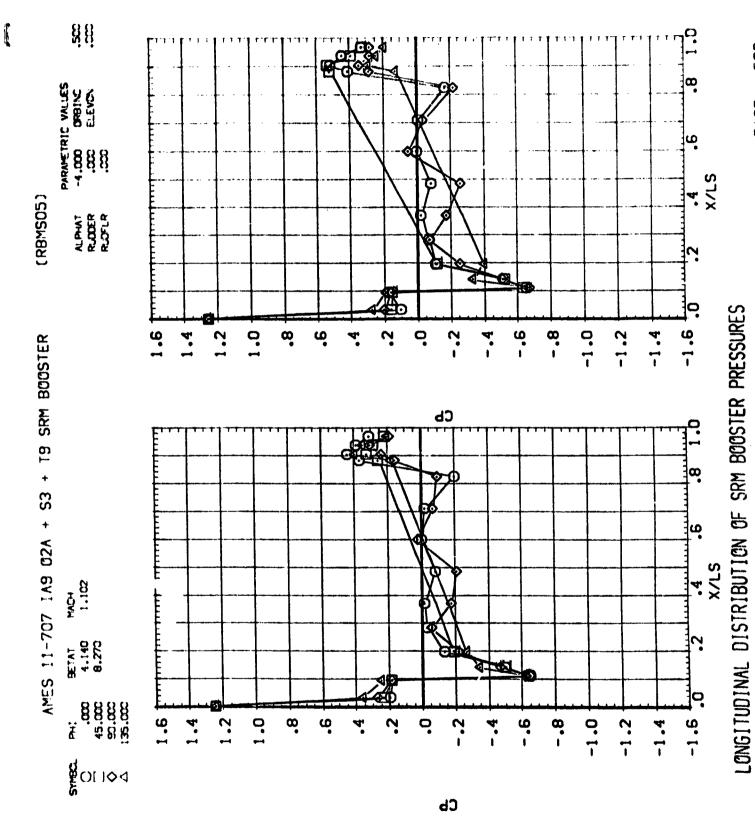




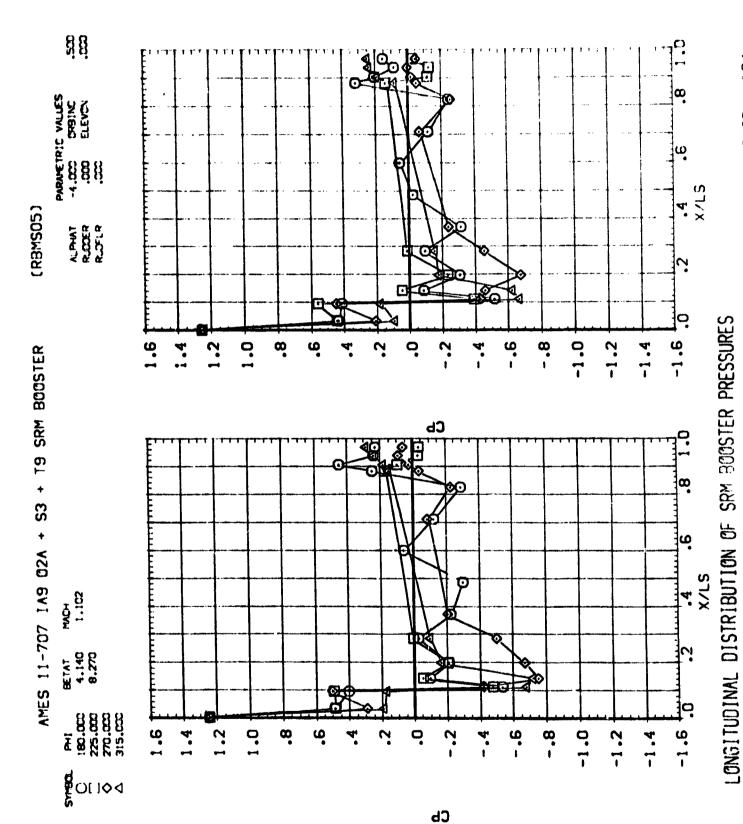




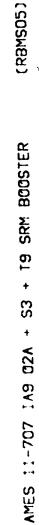
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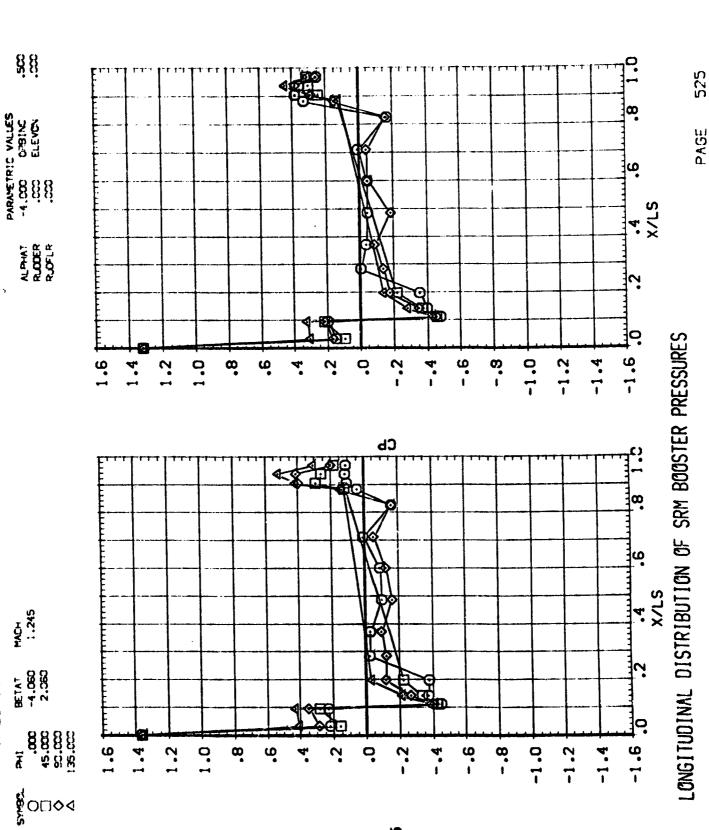






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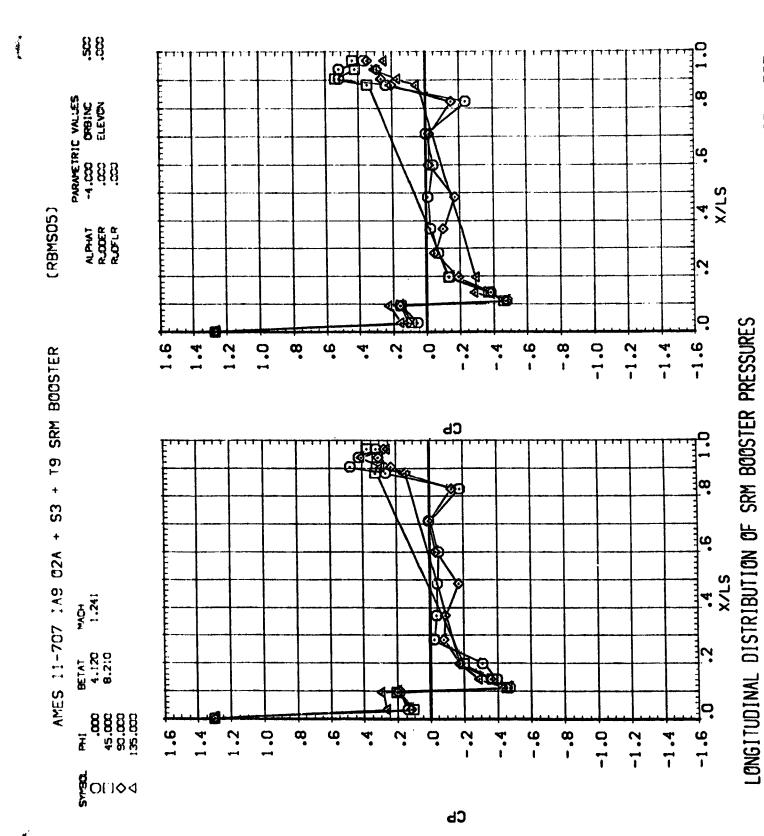
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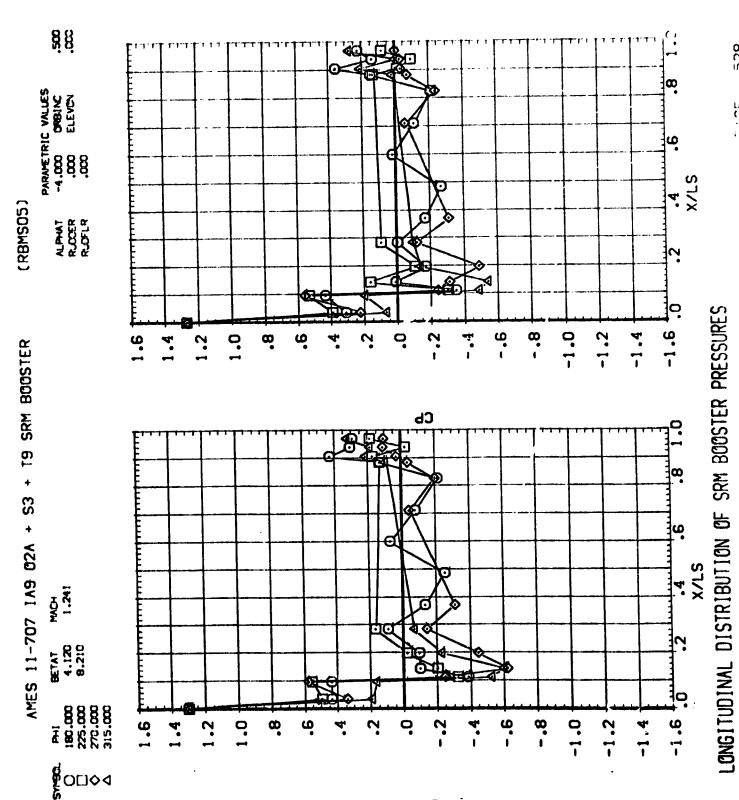
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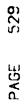
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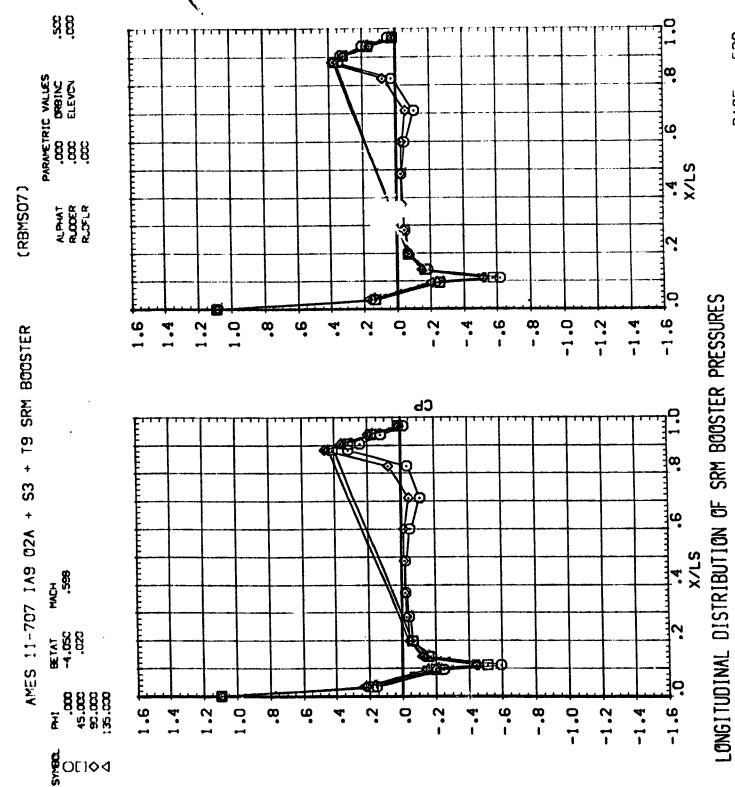


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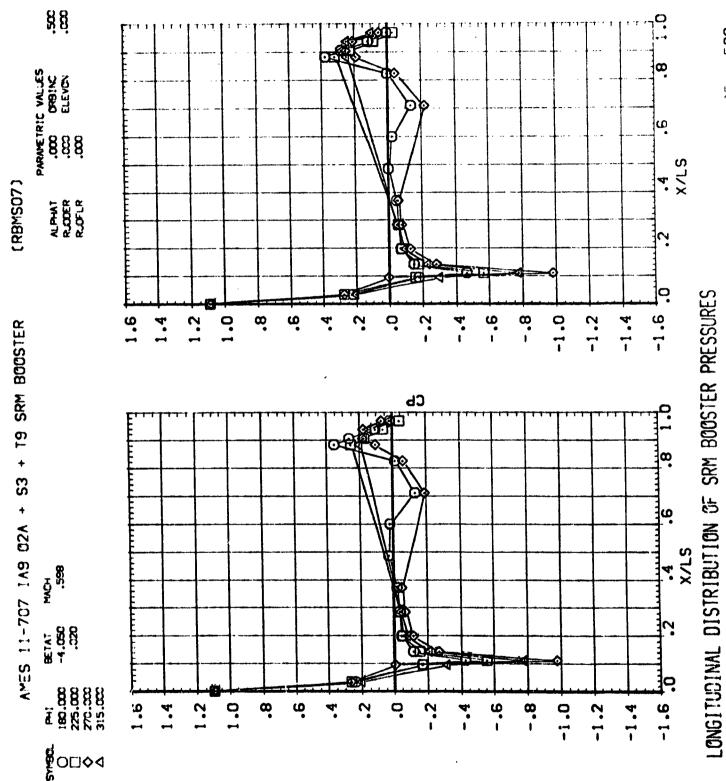


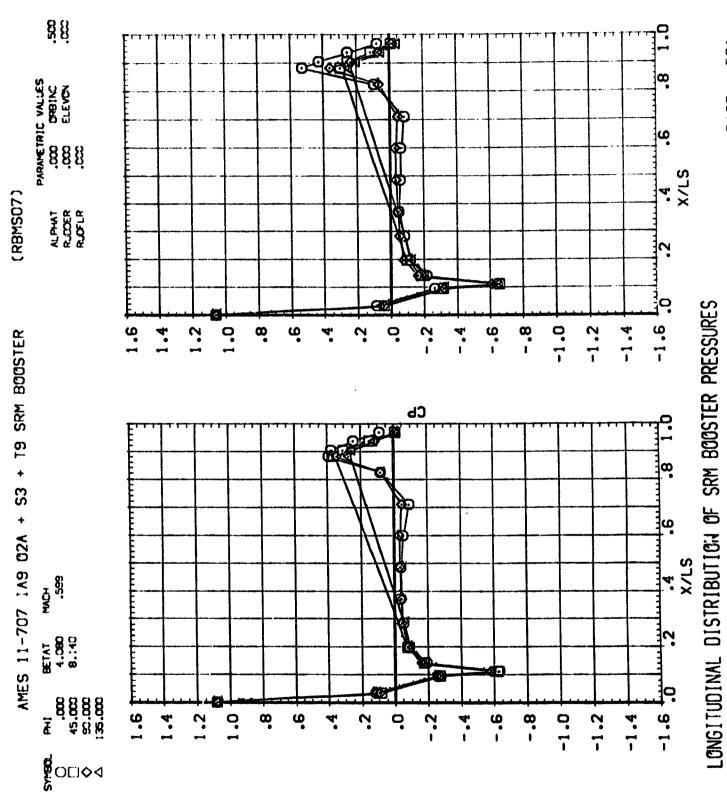




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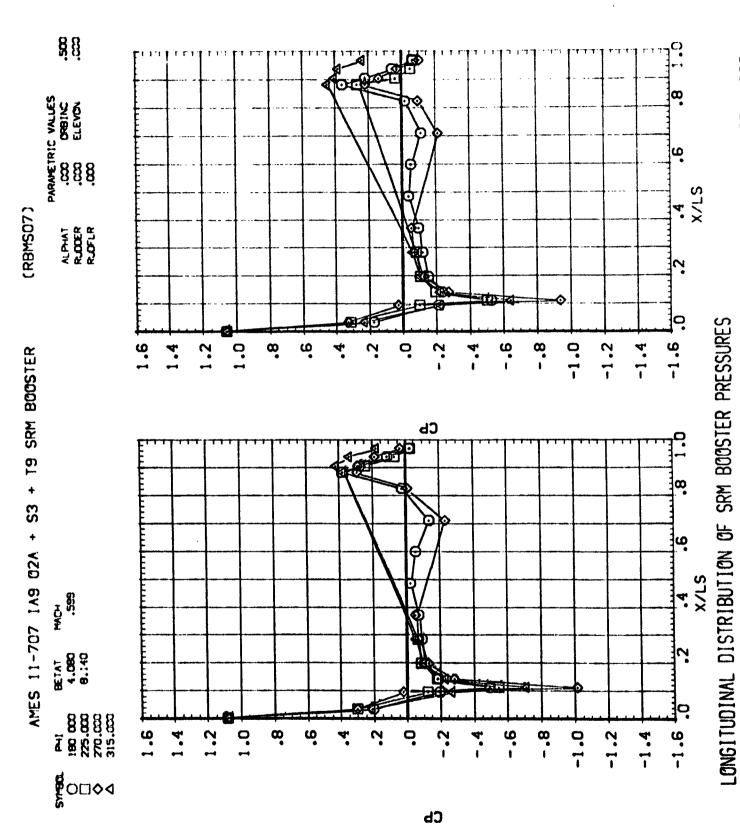




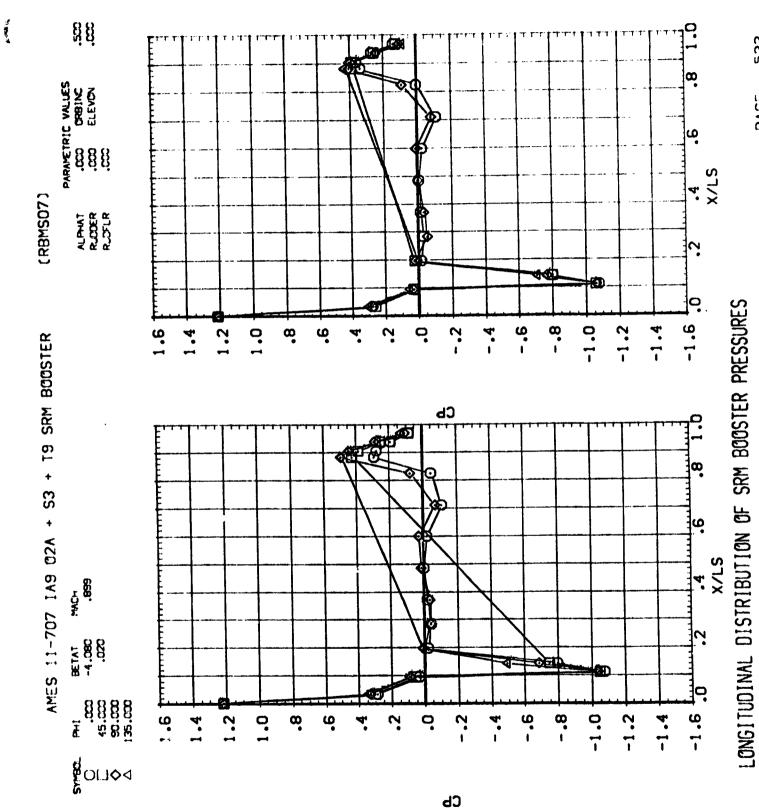


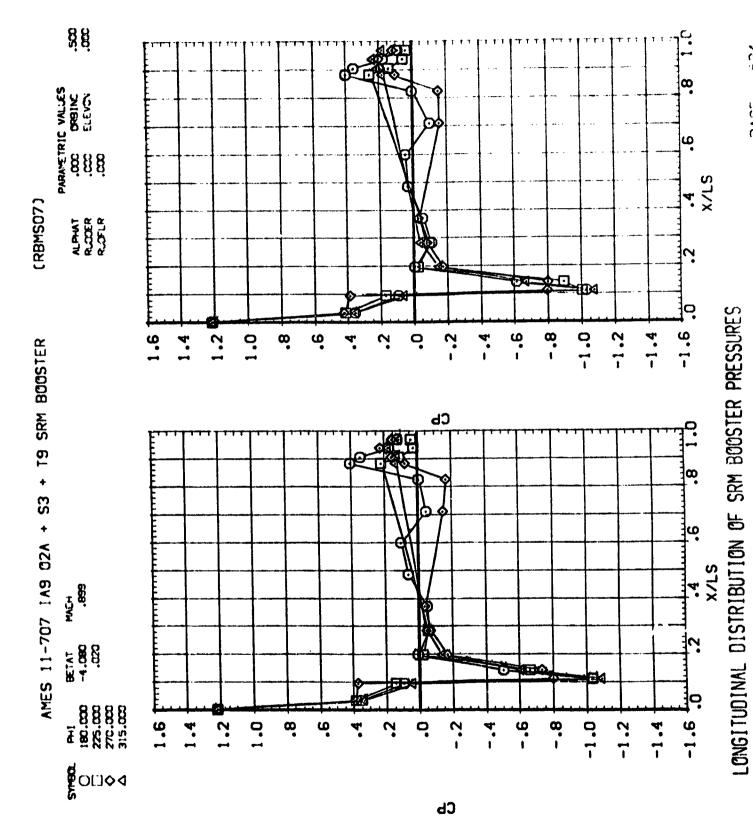
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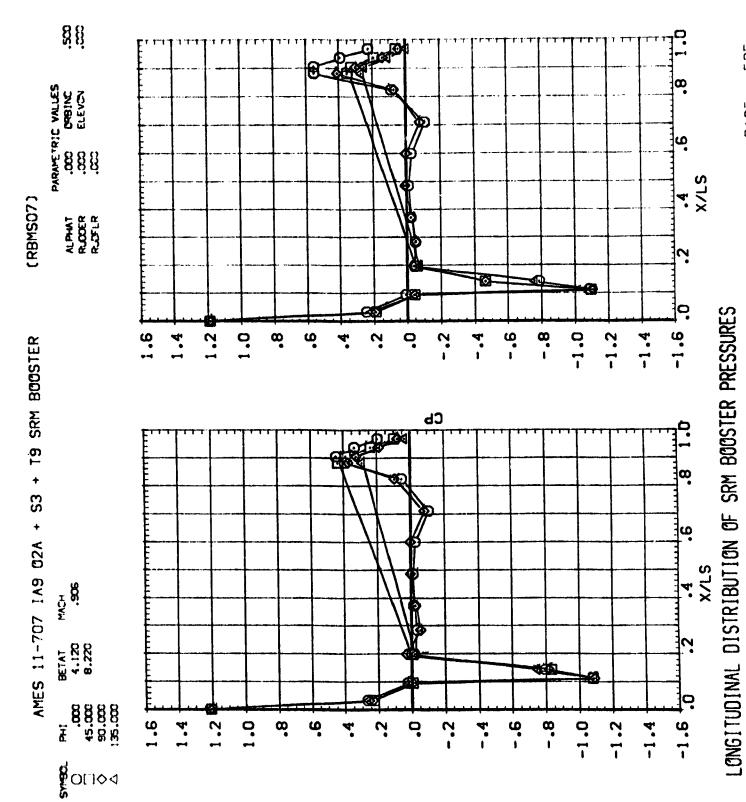
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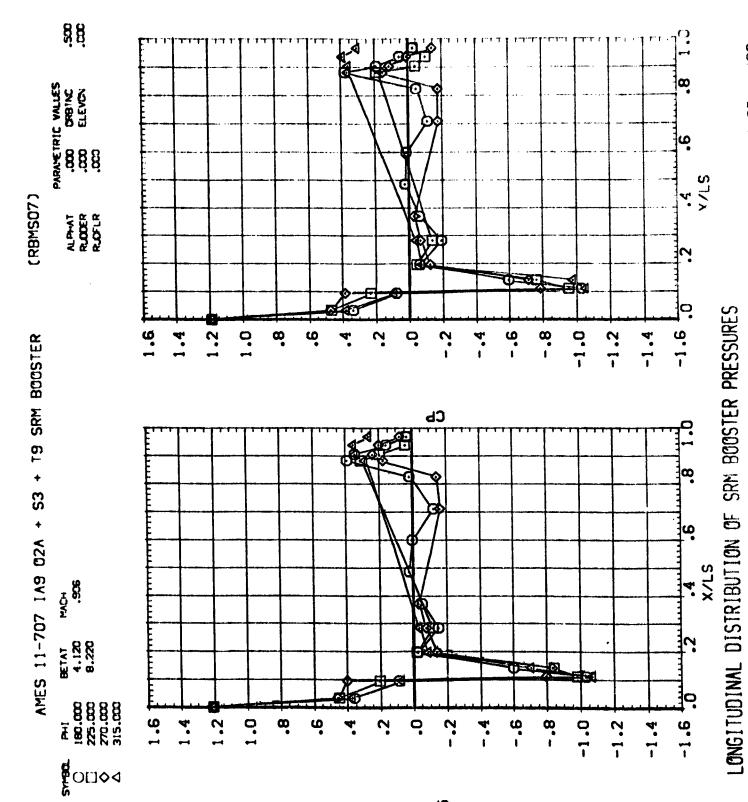




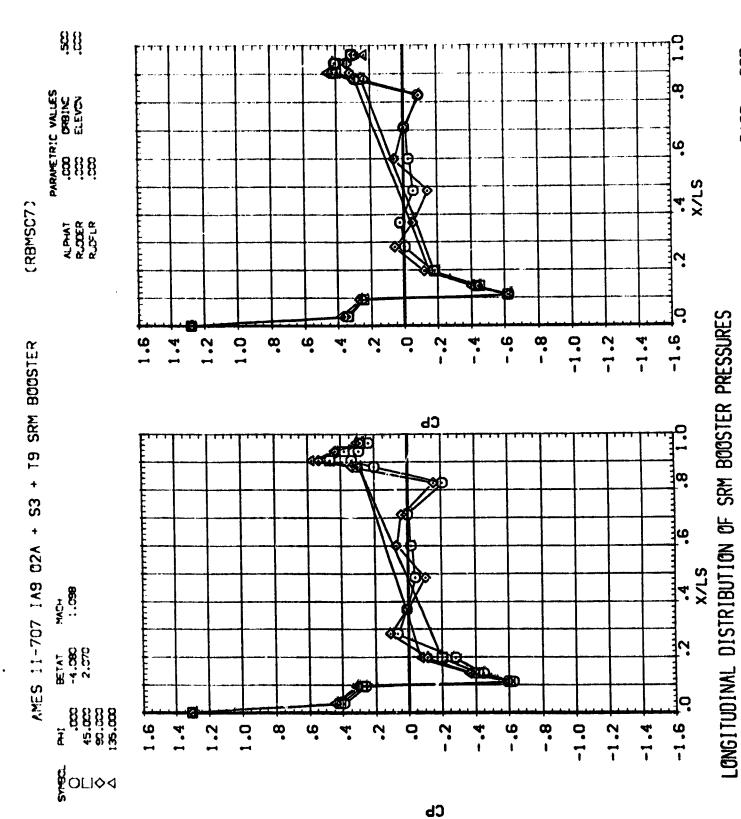


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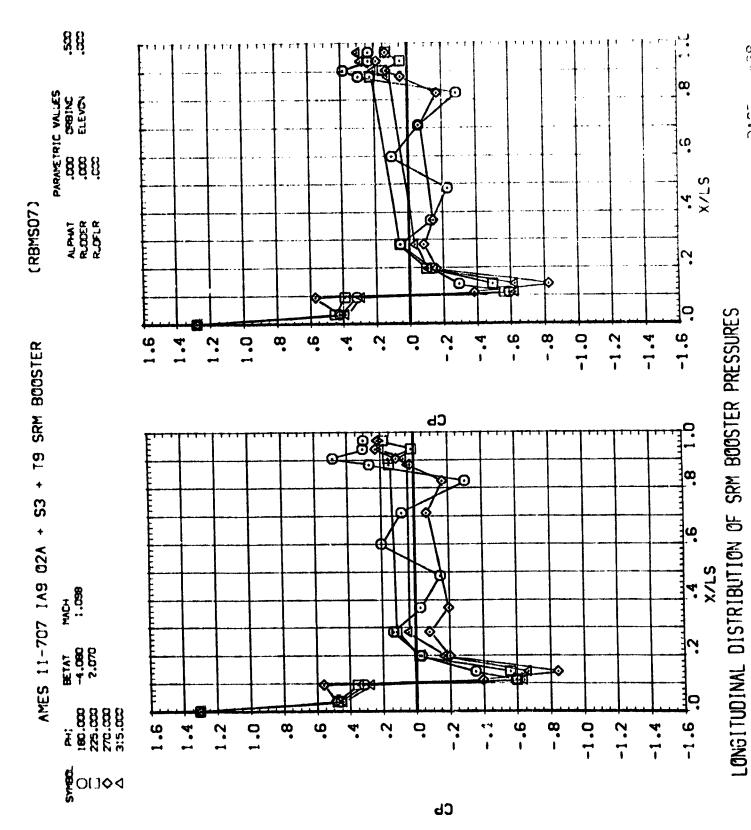


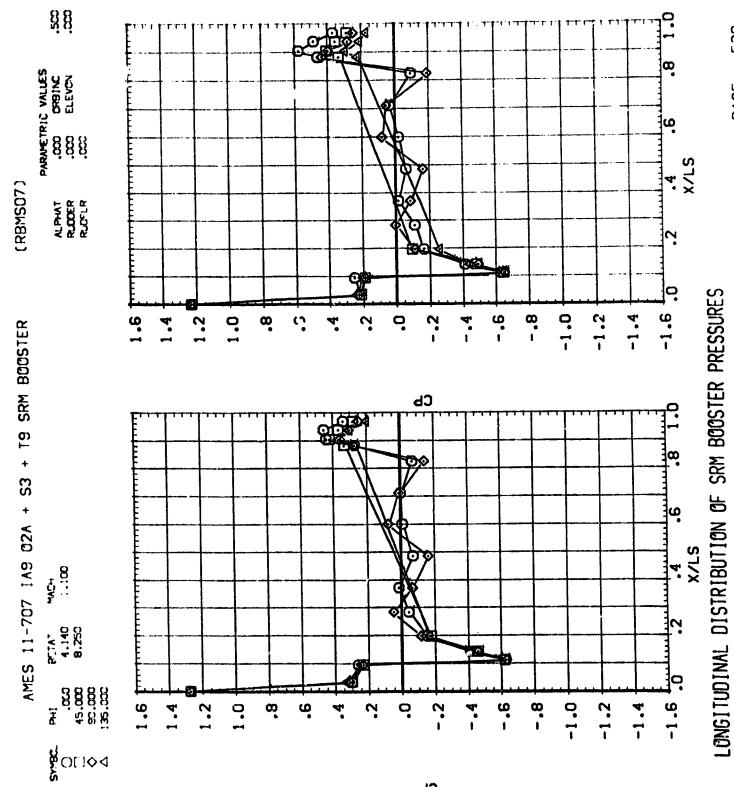


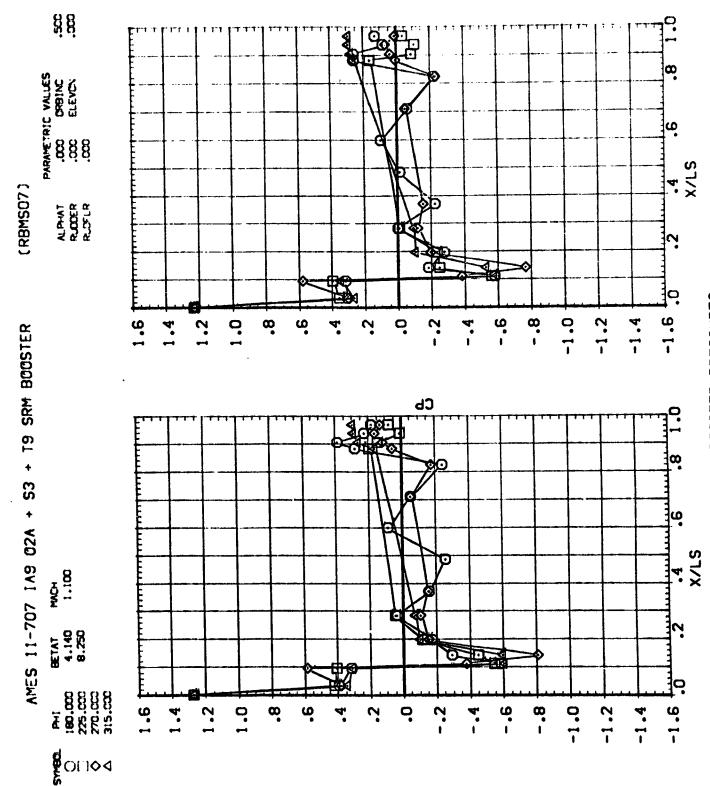
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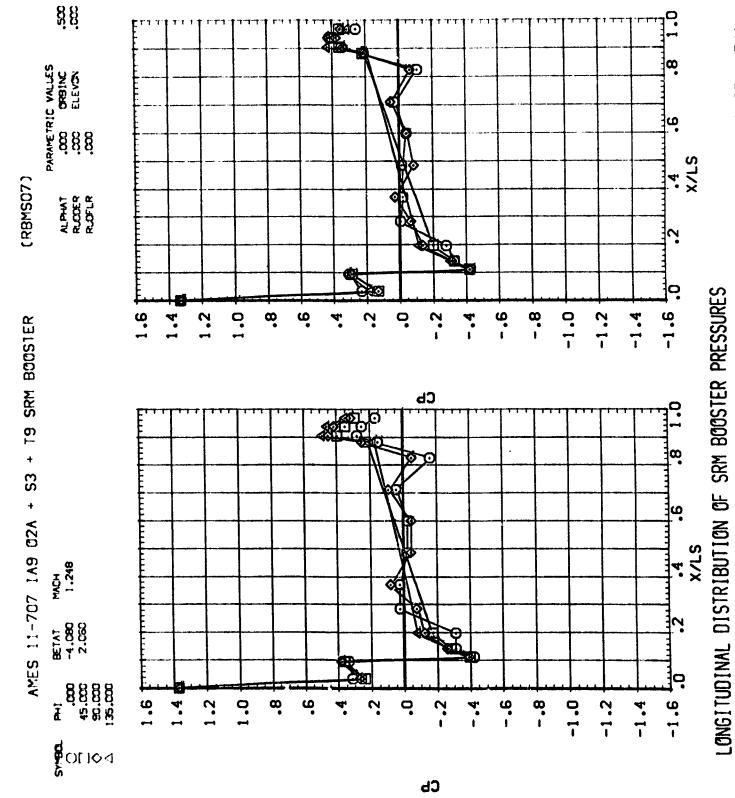
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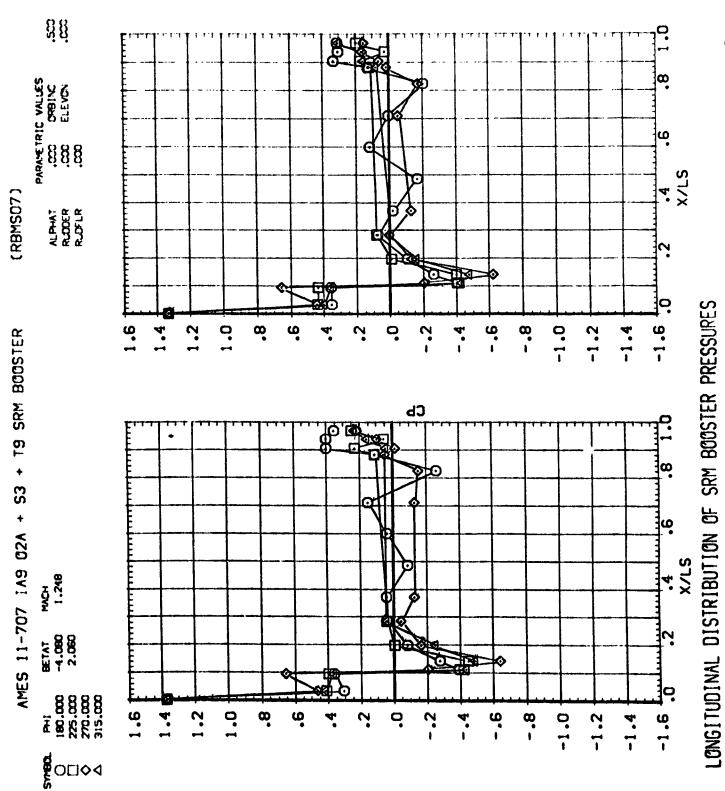




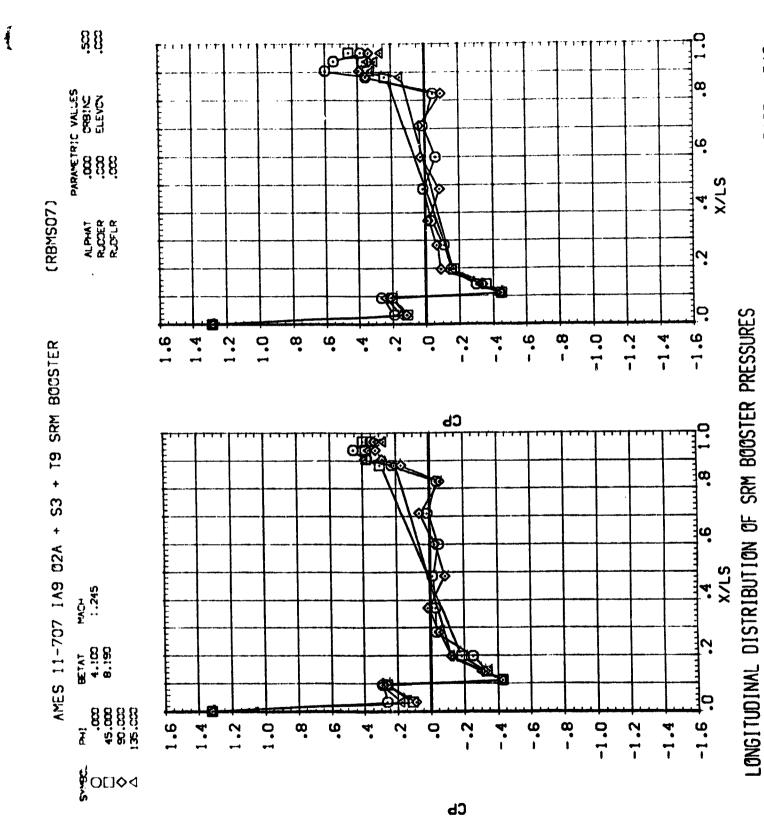
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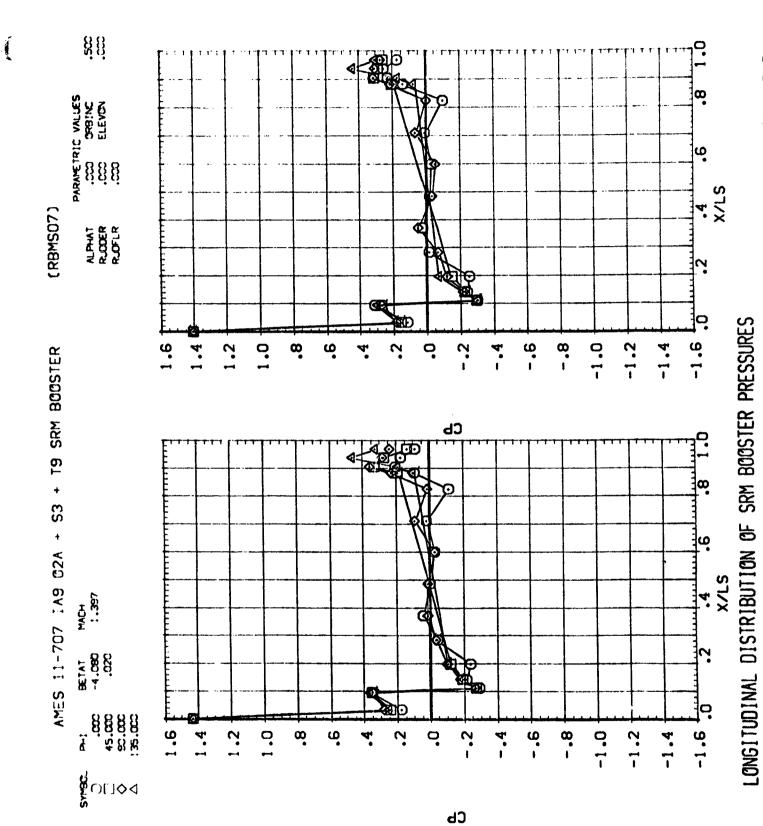
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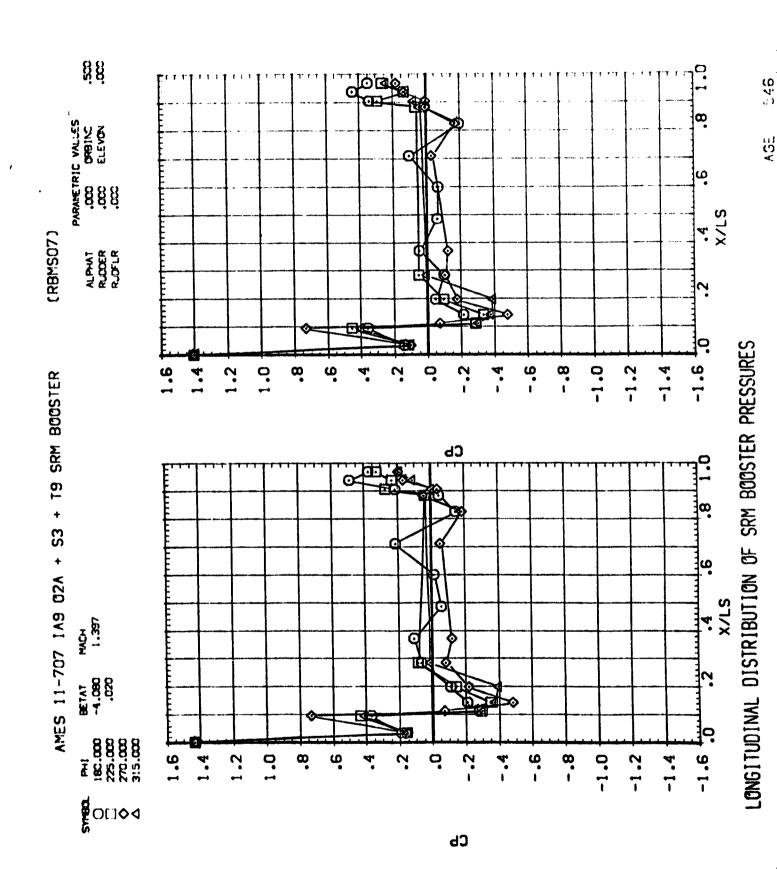
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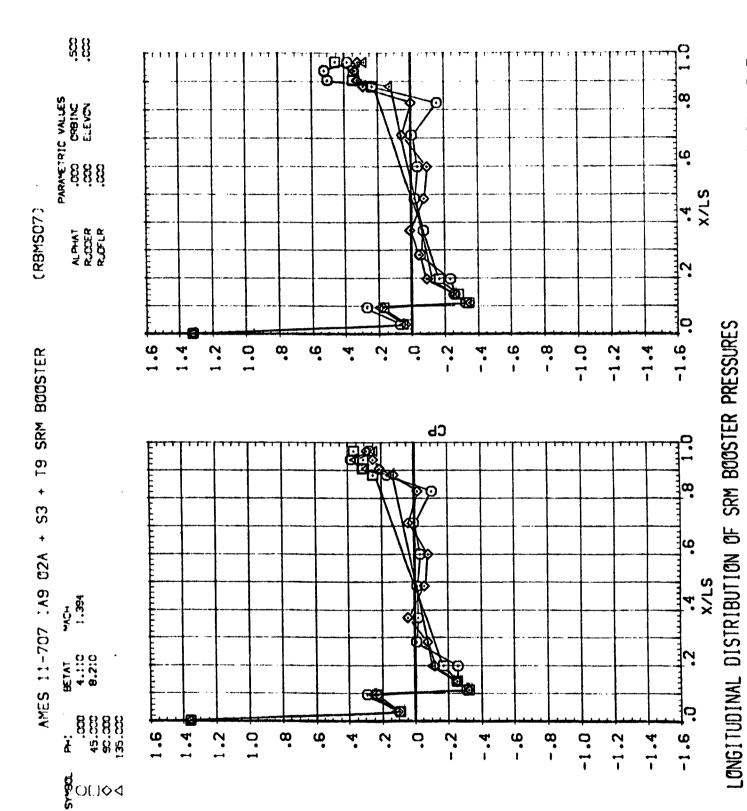
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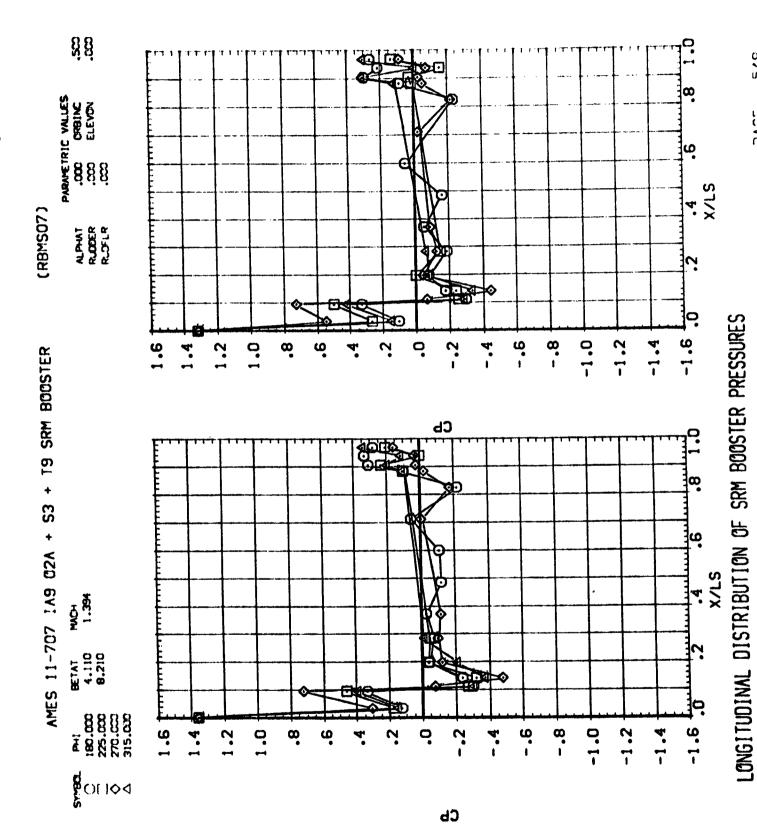
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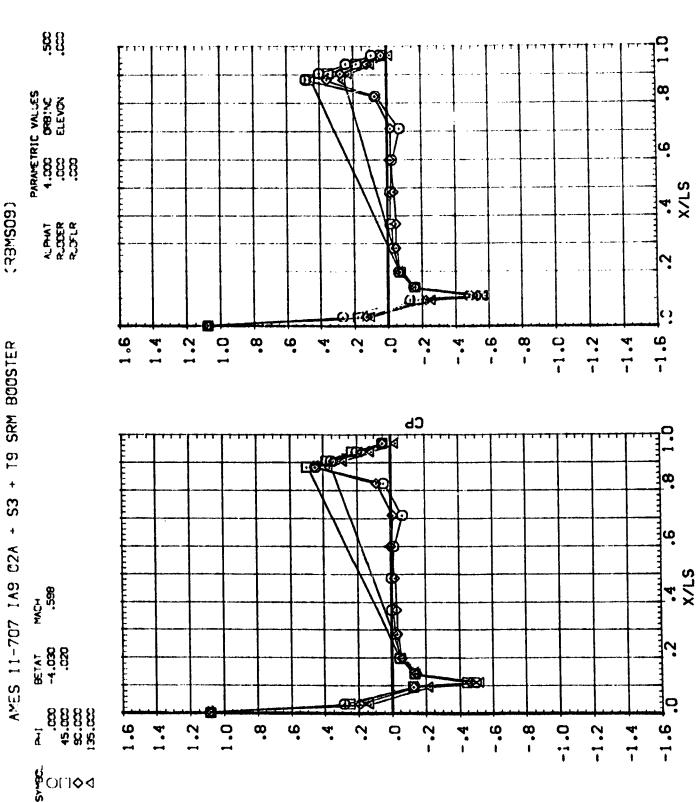
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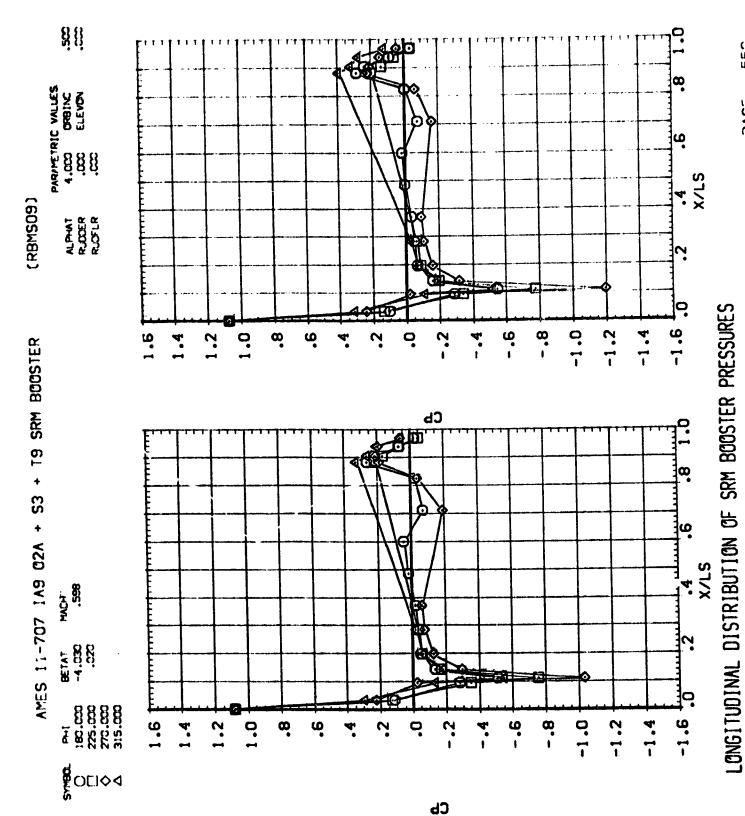


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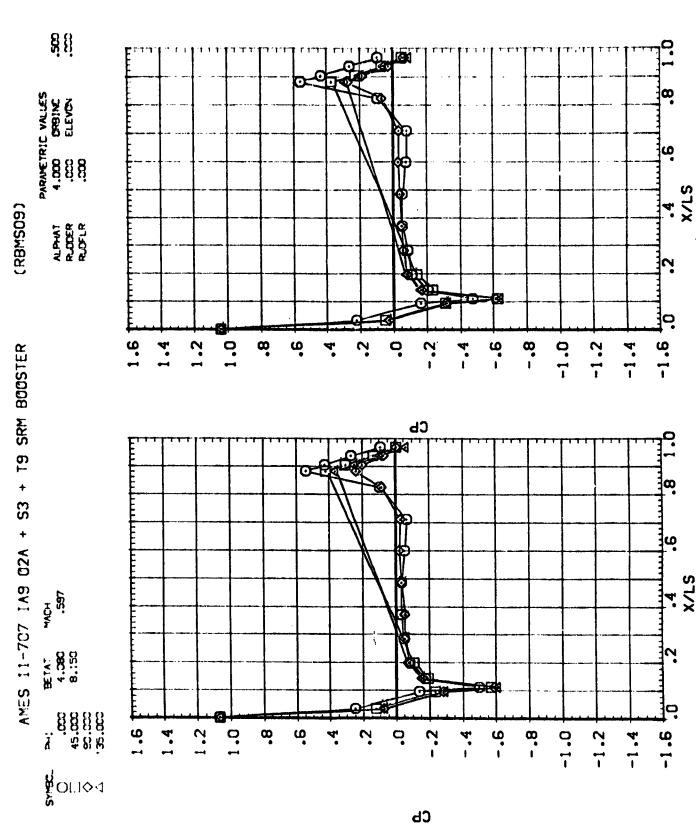


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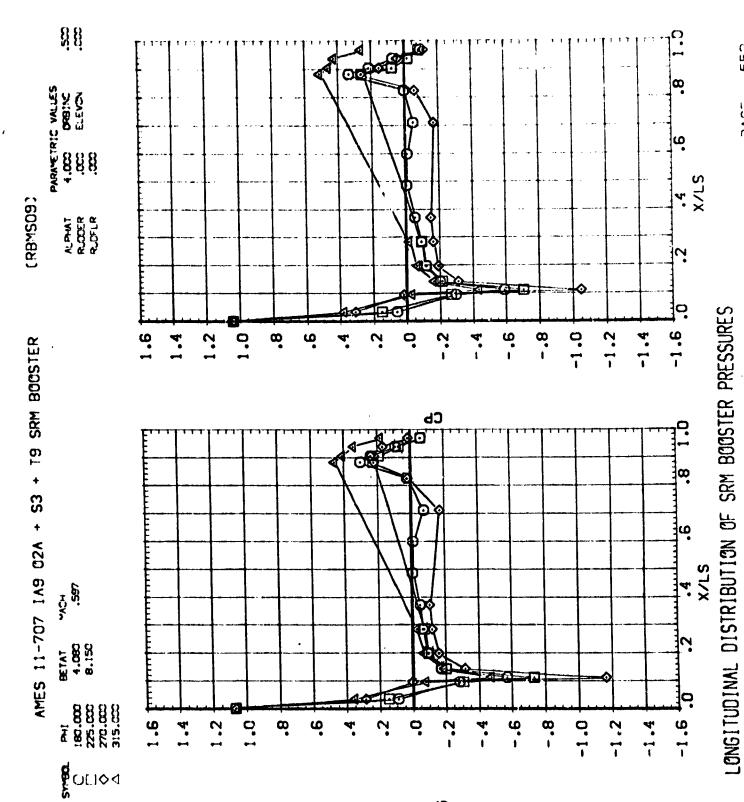






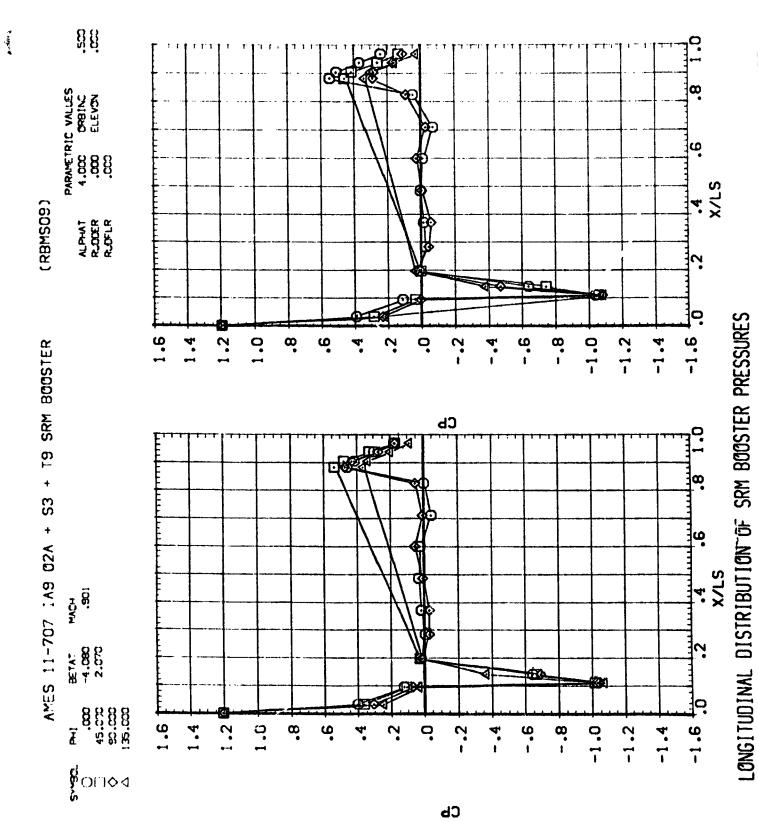






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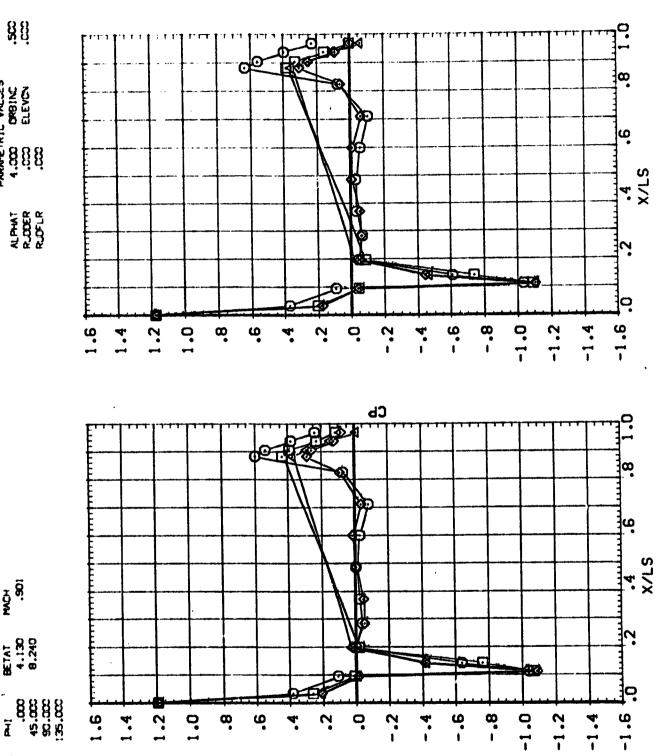
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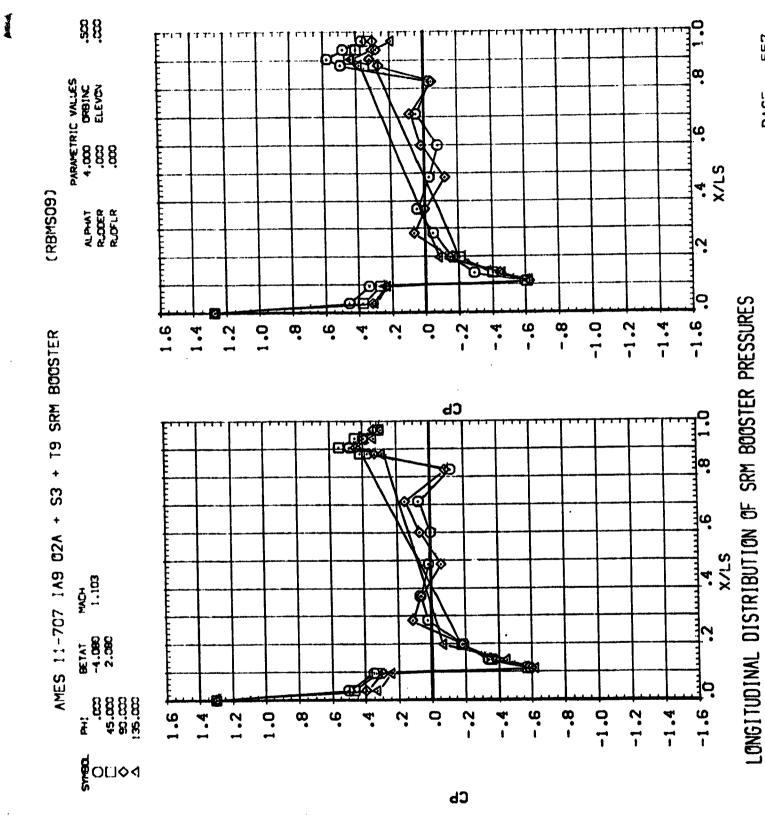


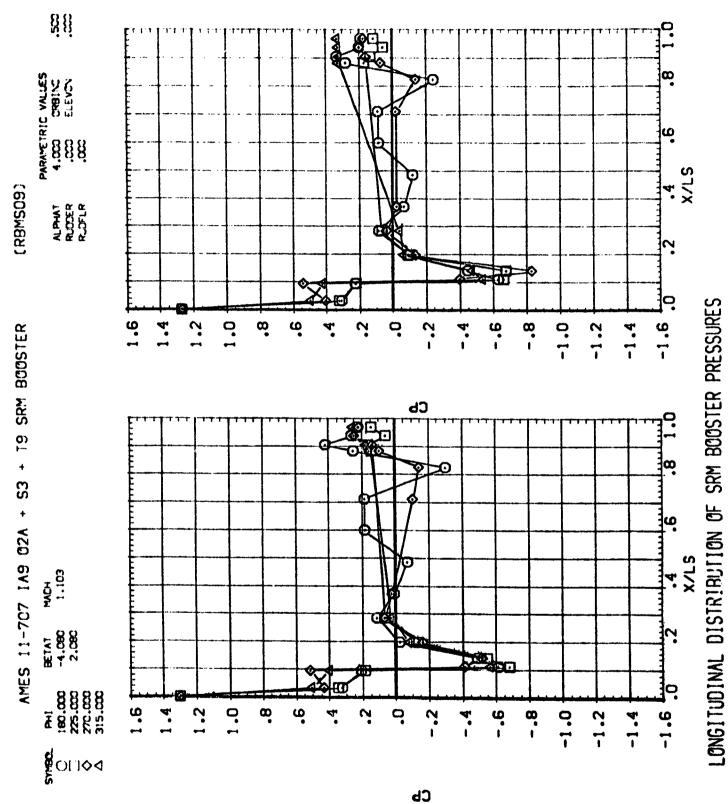
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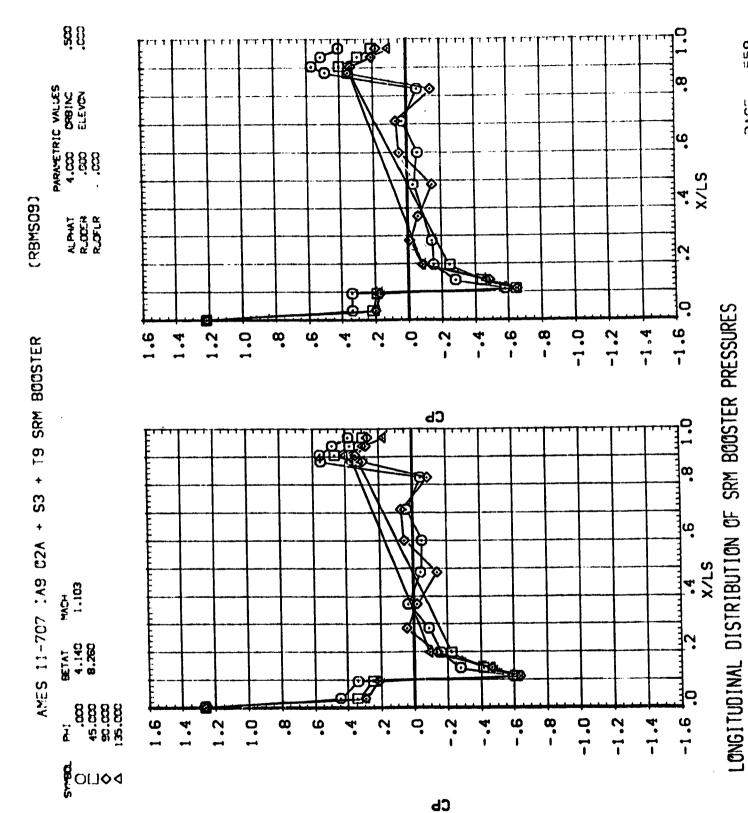
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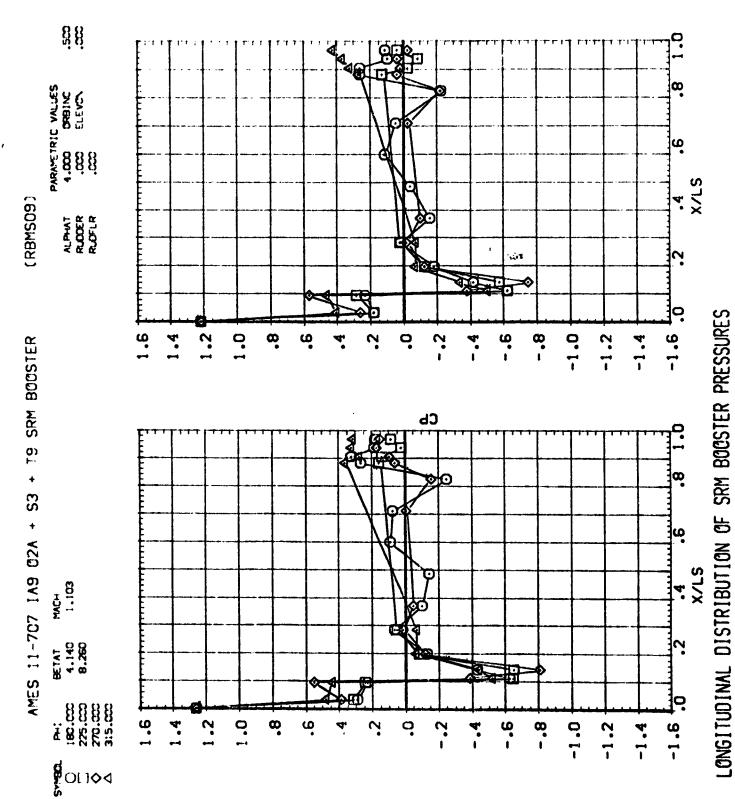




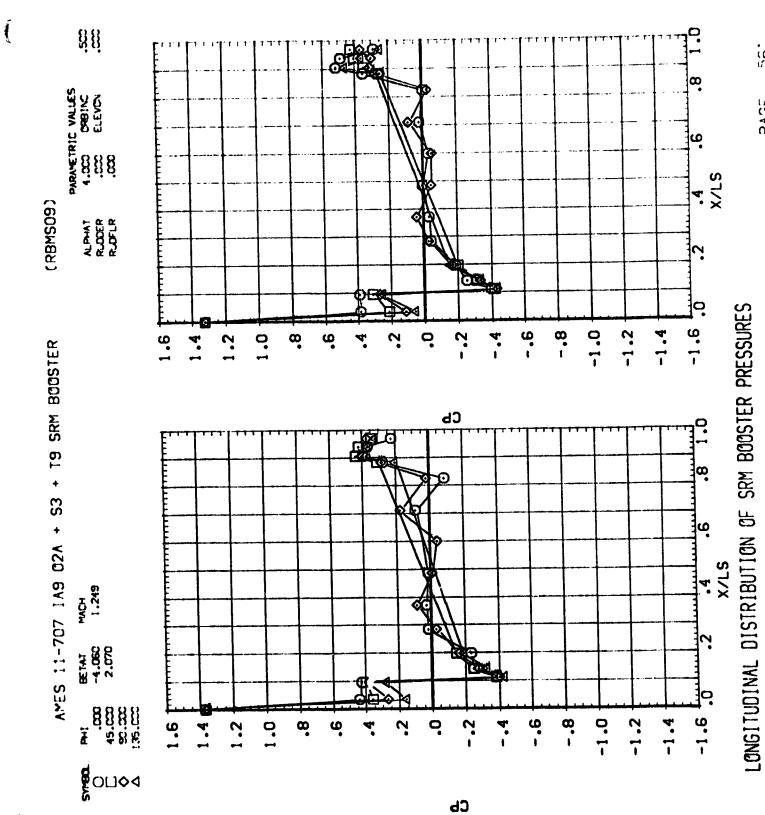


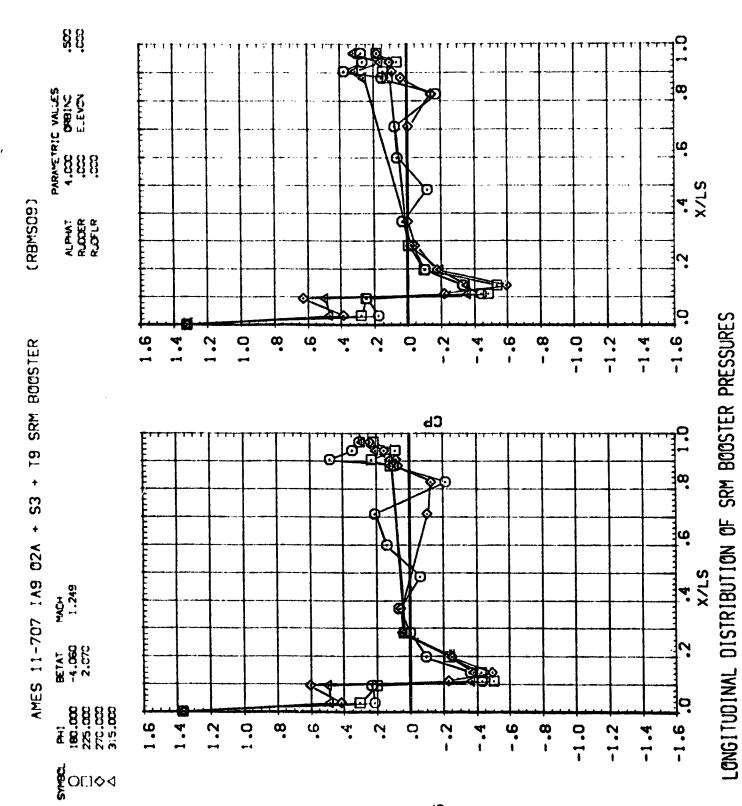


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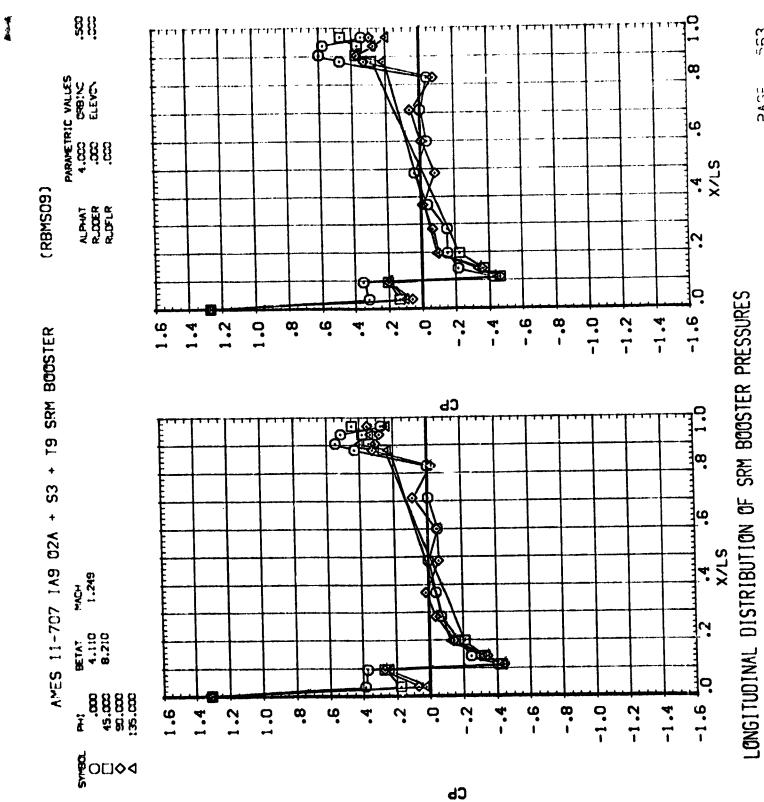


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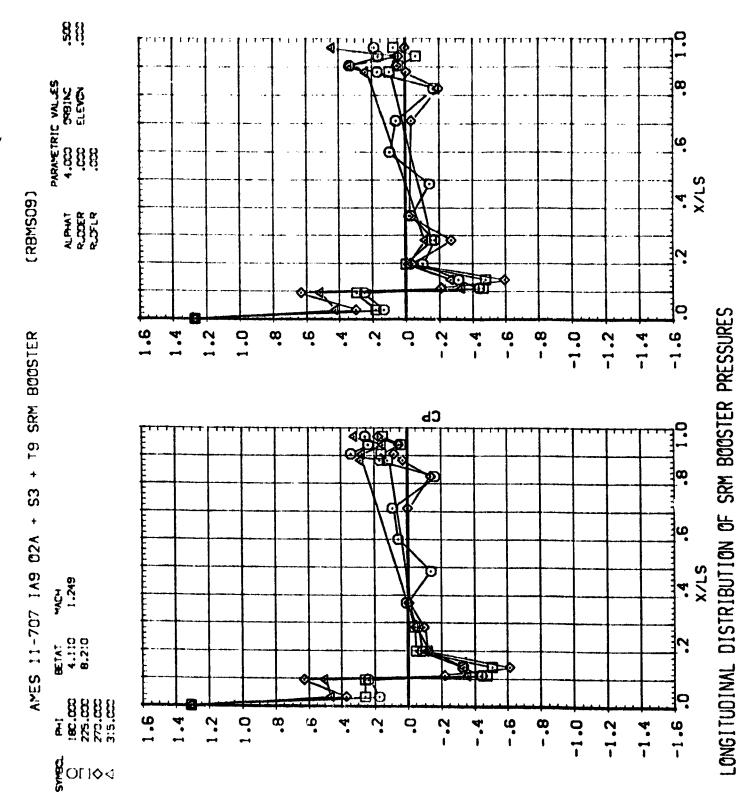




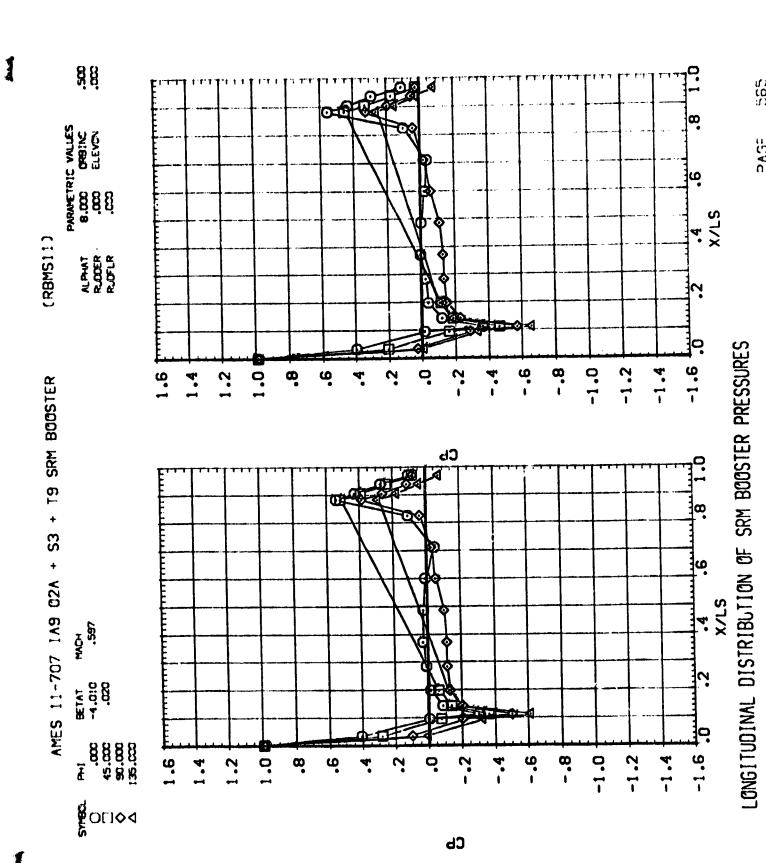


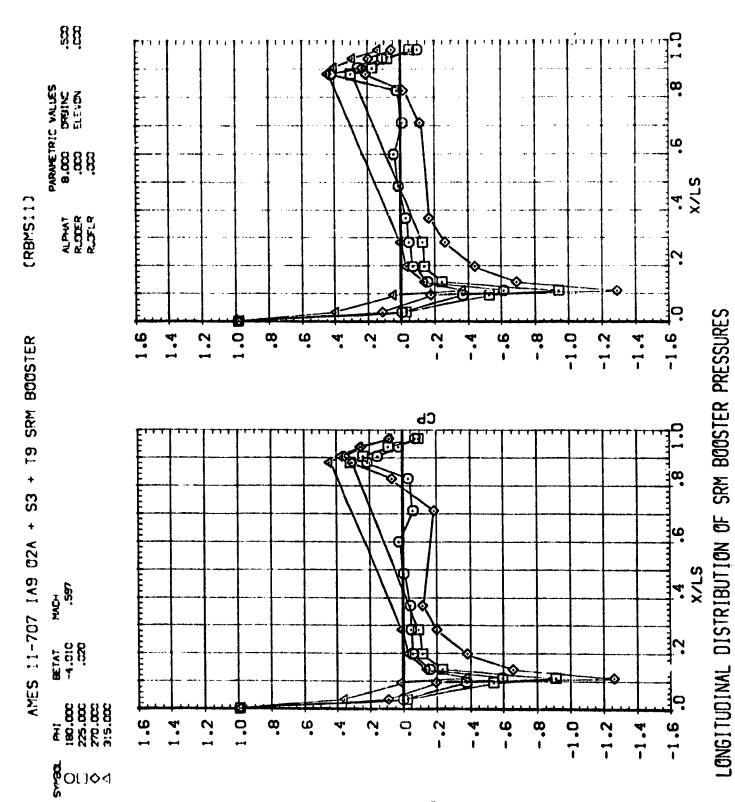






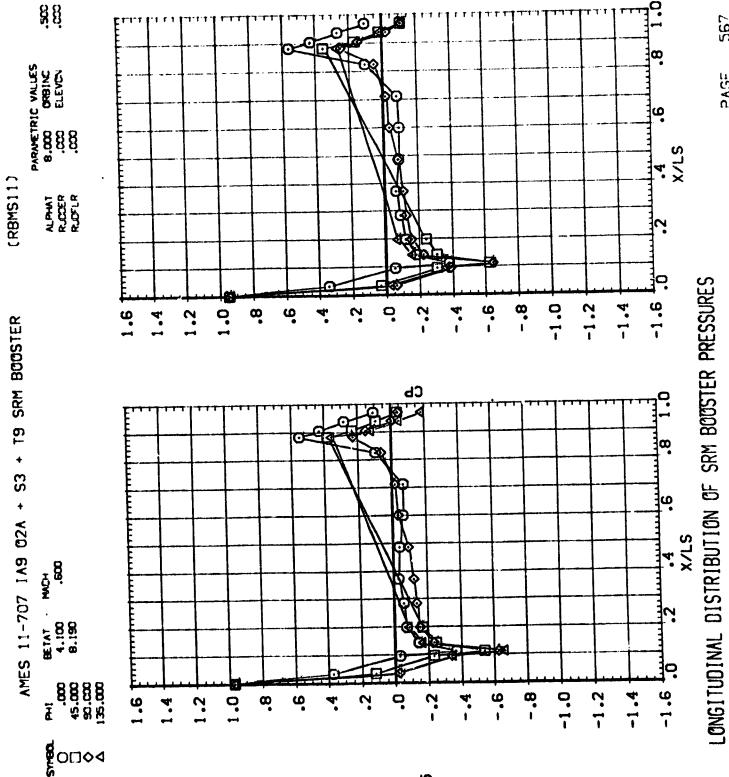
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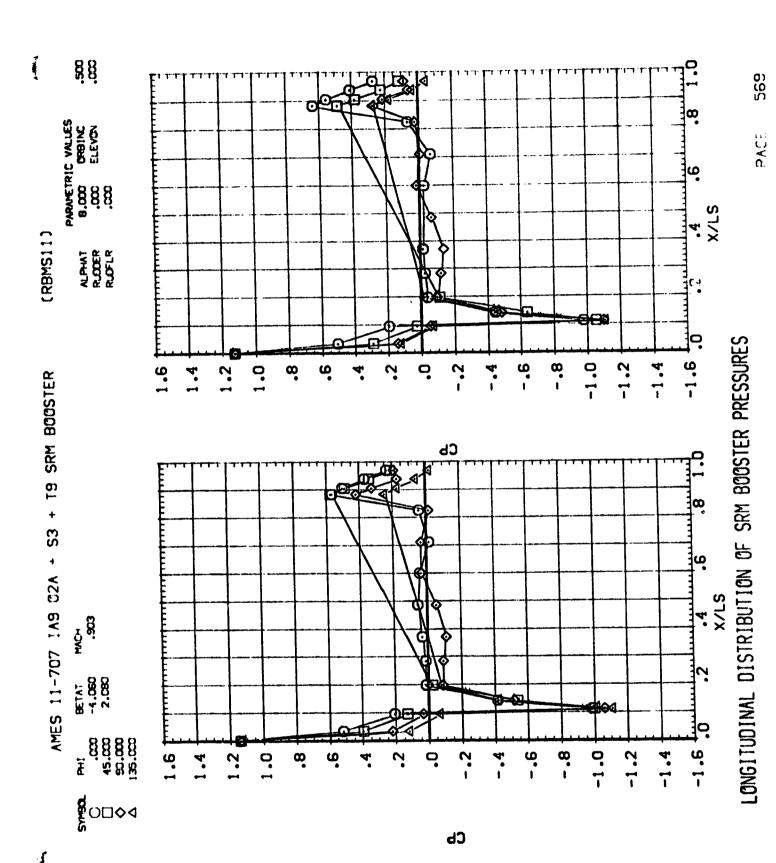


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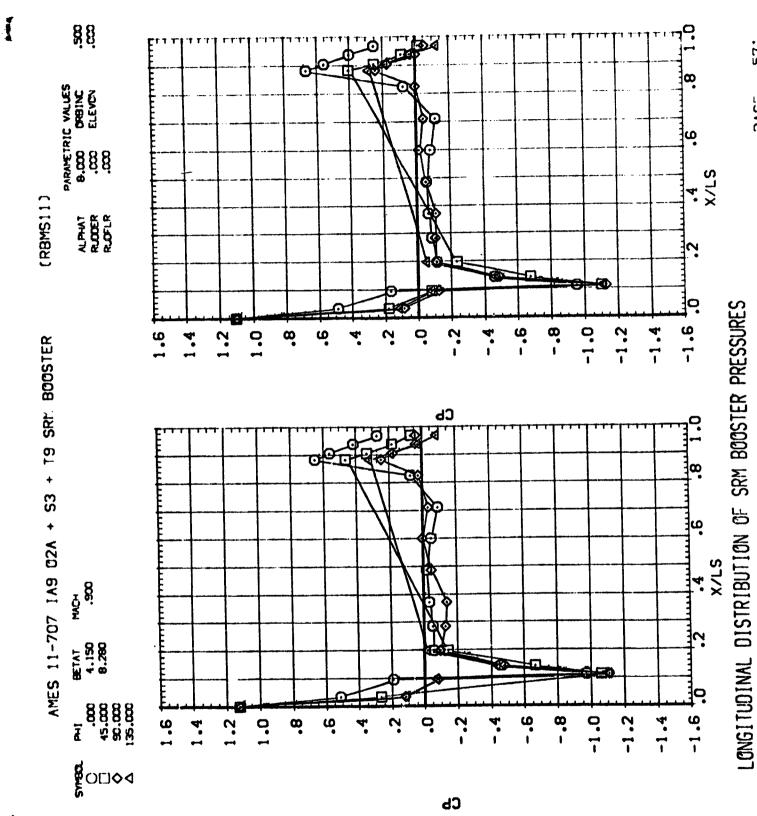
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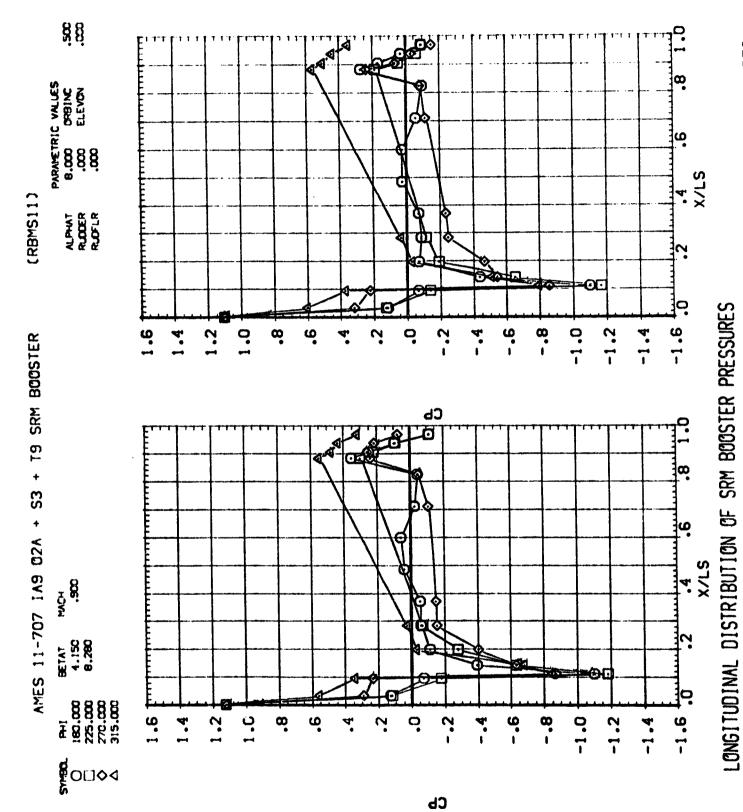


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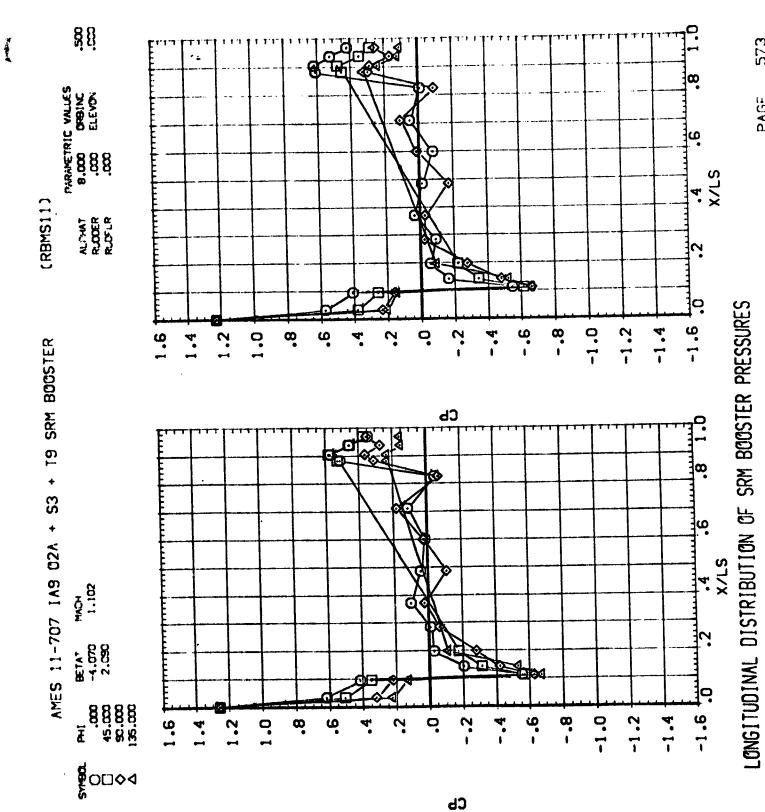
LONGITUDINAL DISTRIBUTION OF SRM BOOSTER PRESSURES

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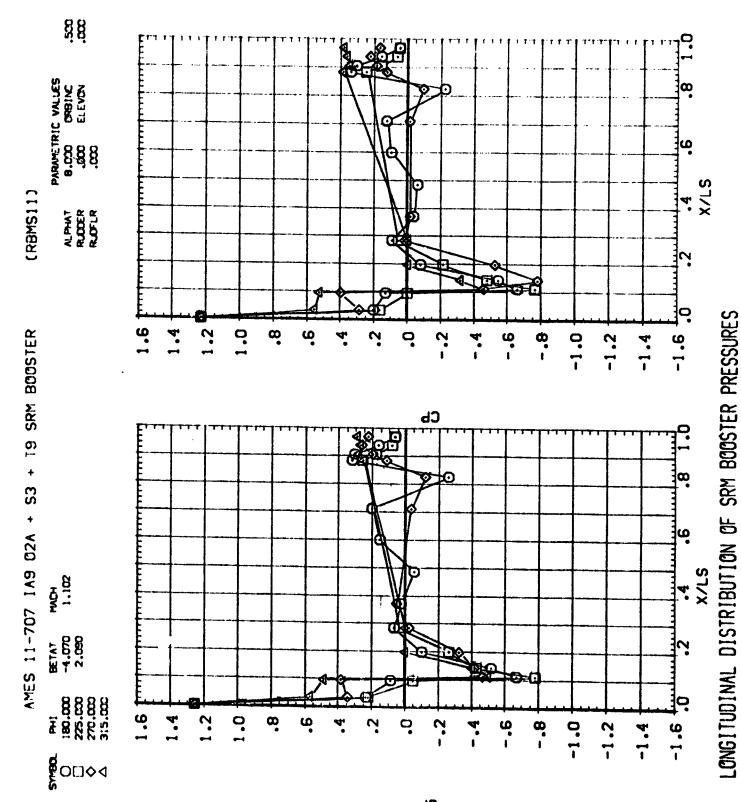




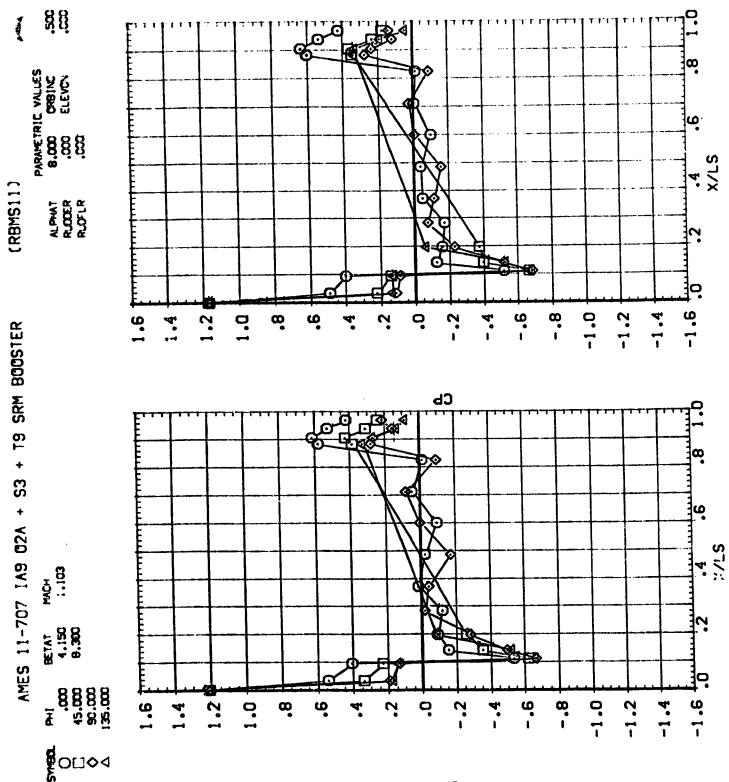




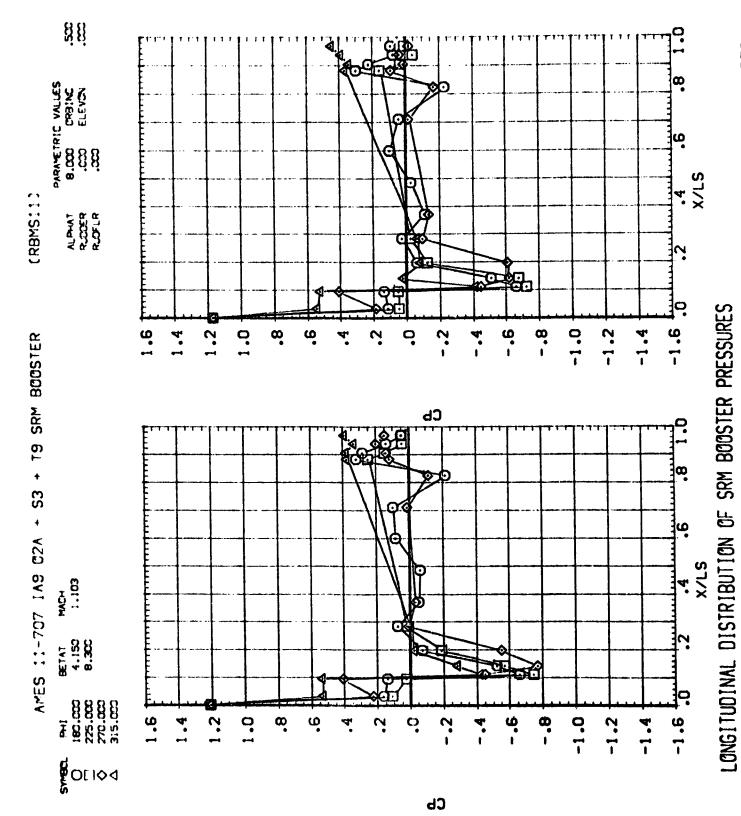




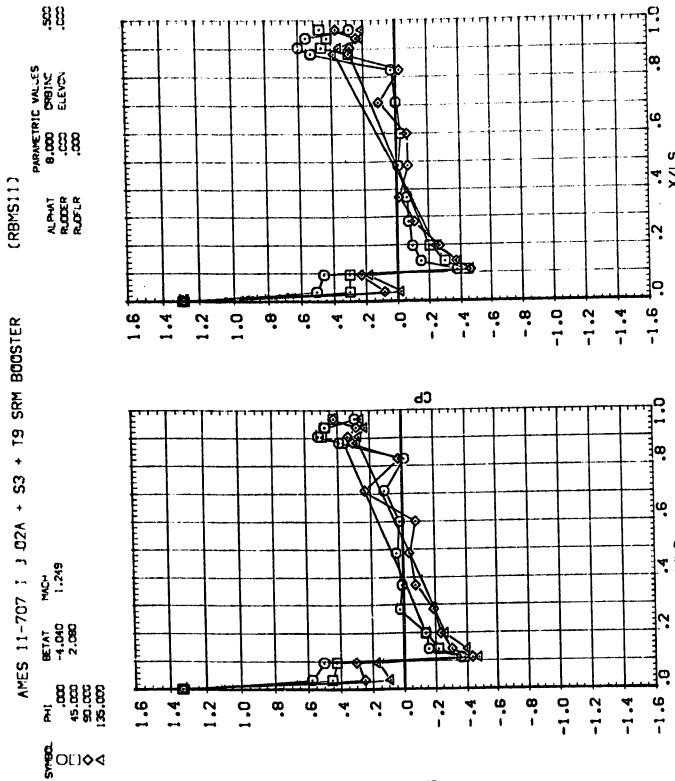
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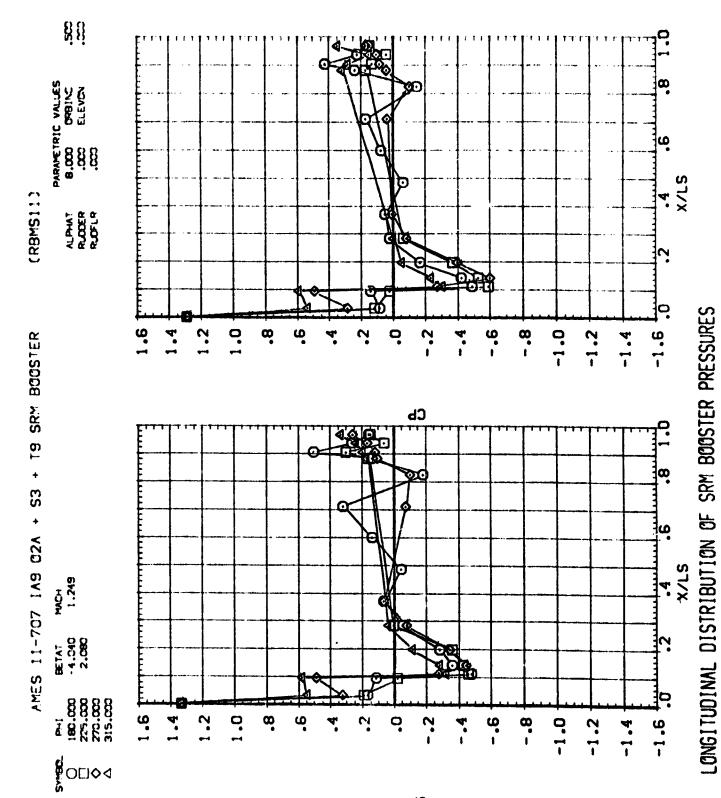


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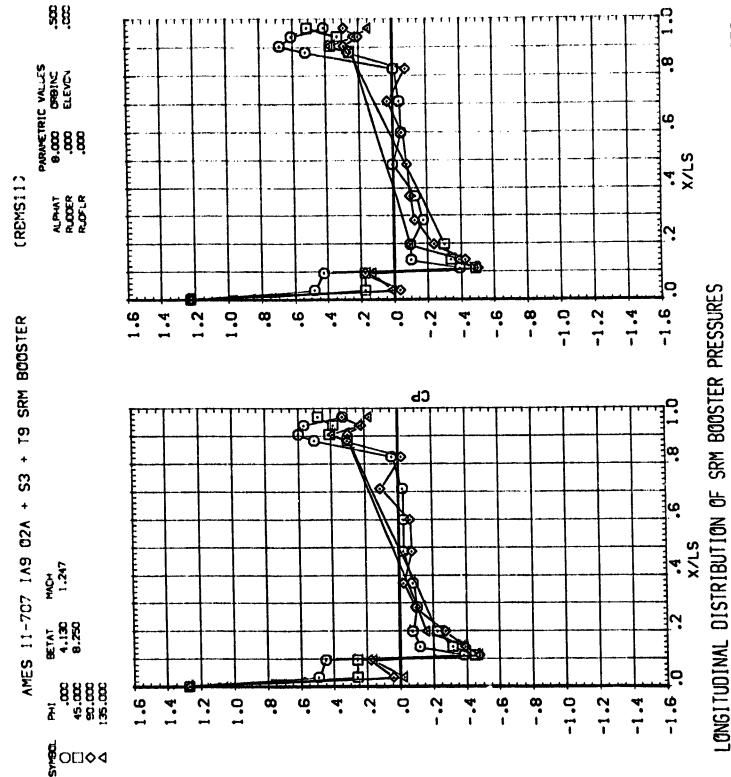


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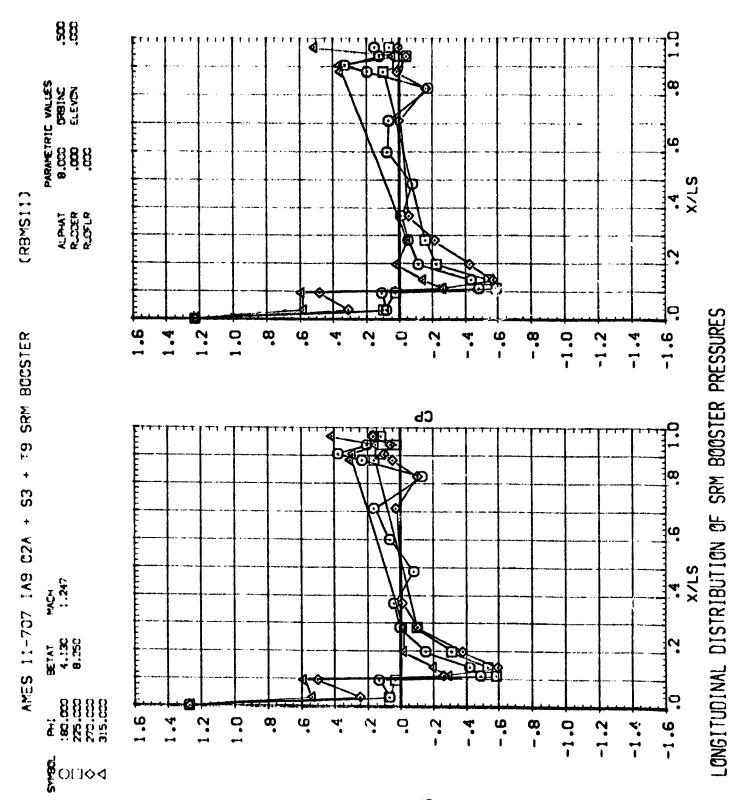




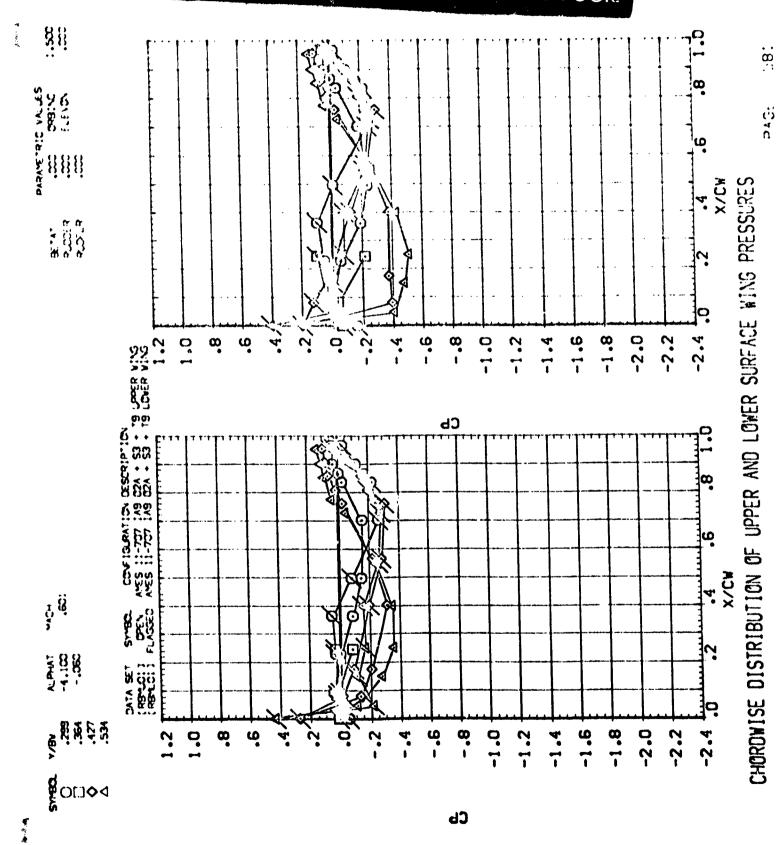


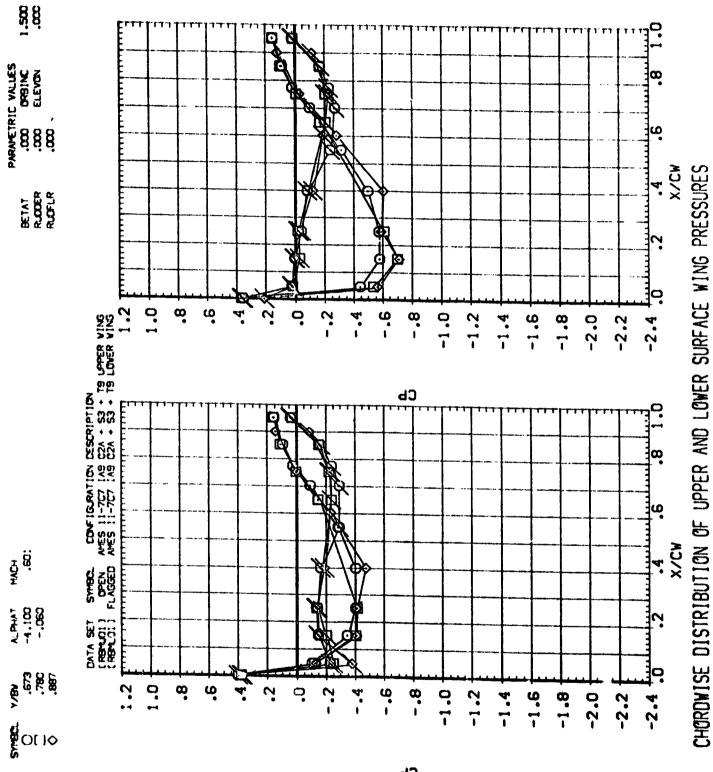


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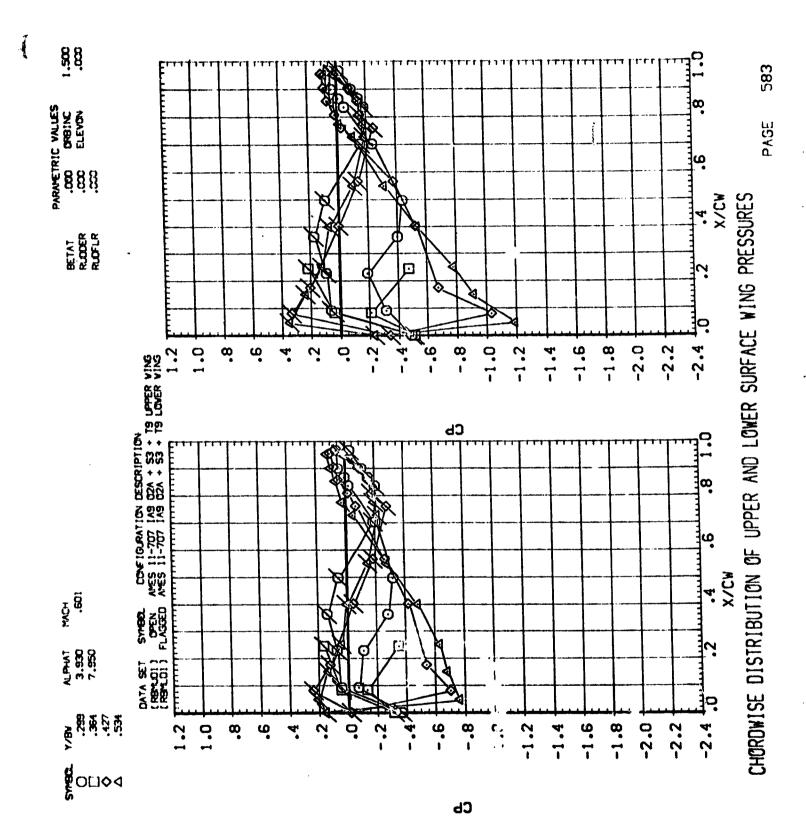
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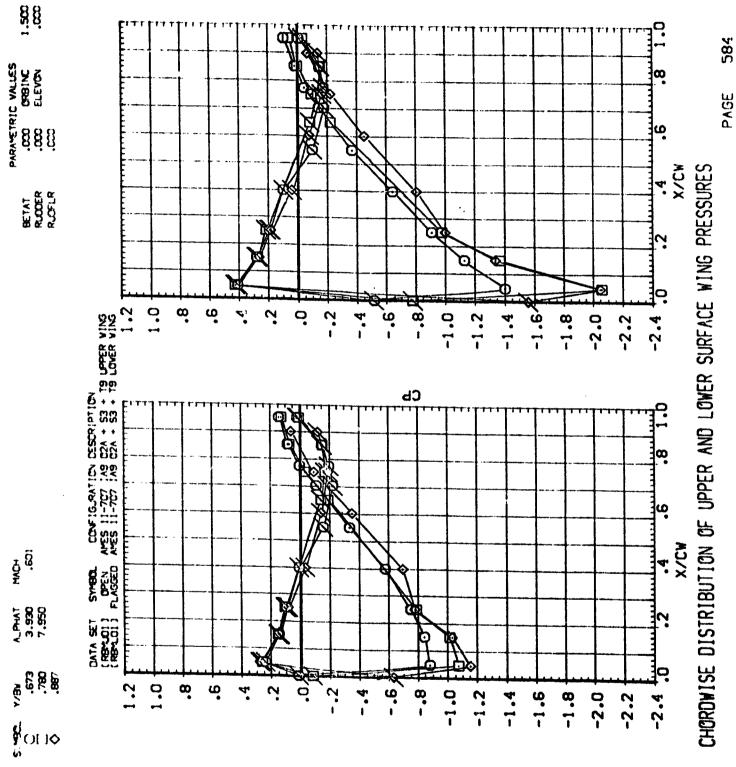




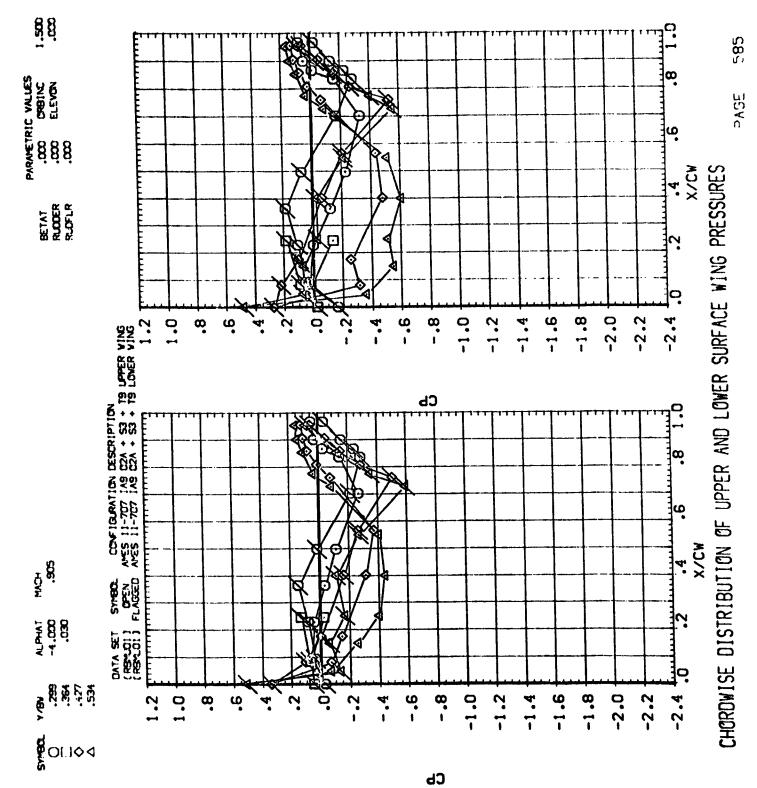
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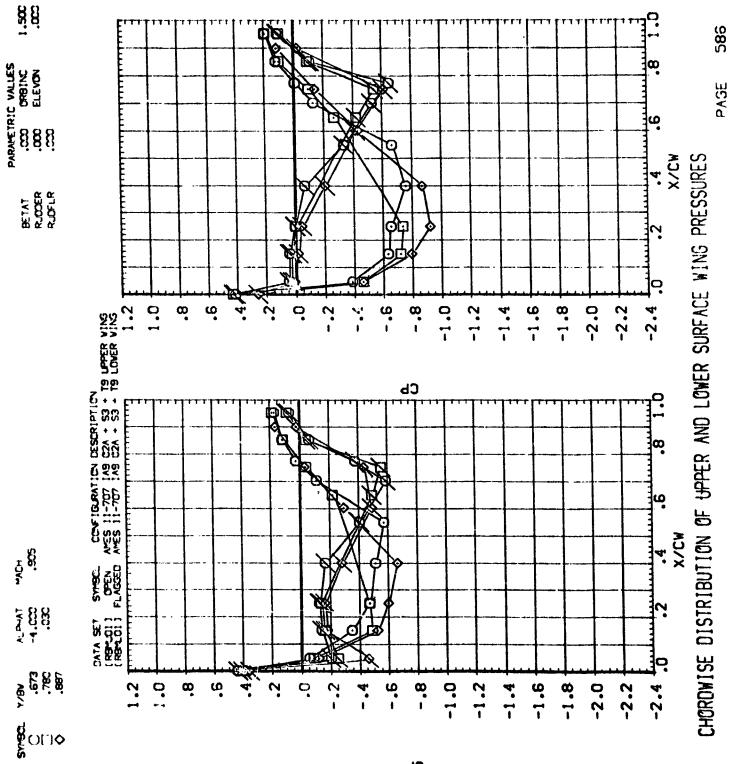
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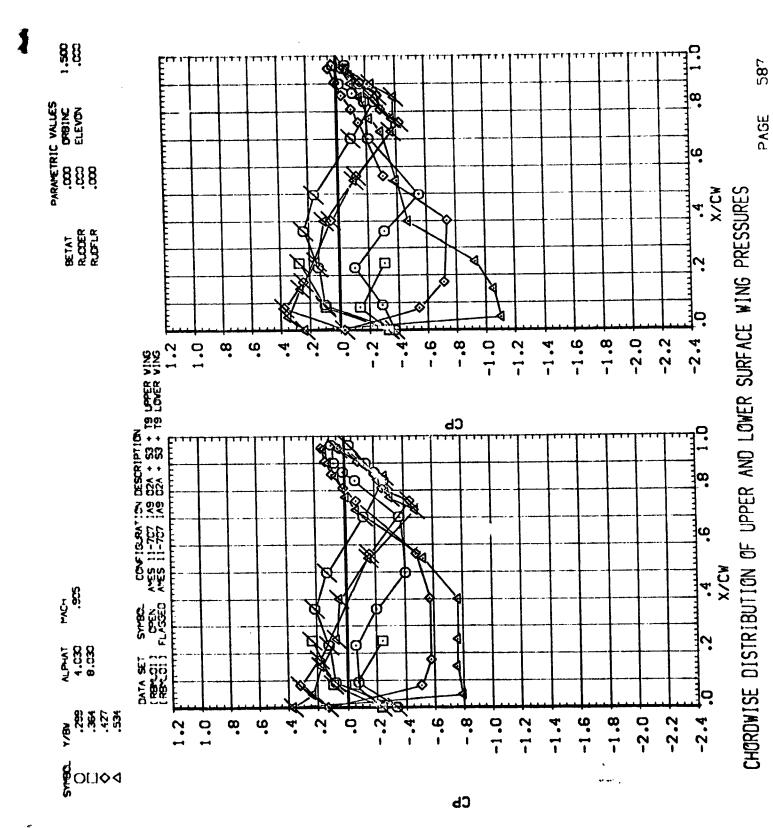


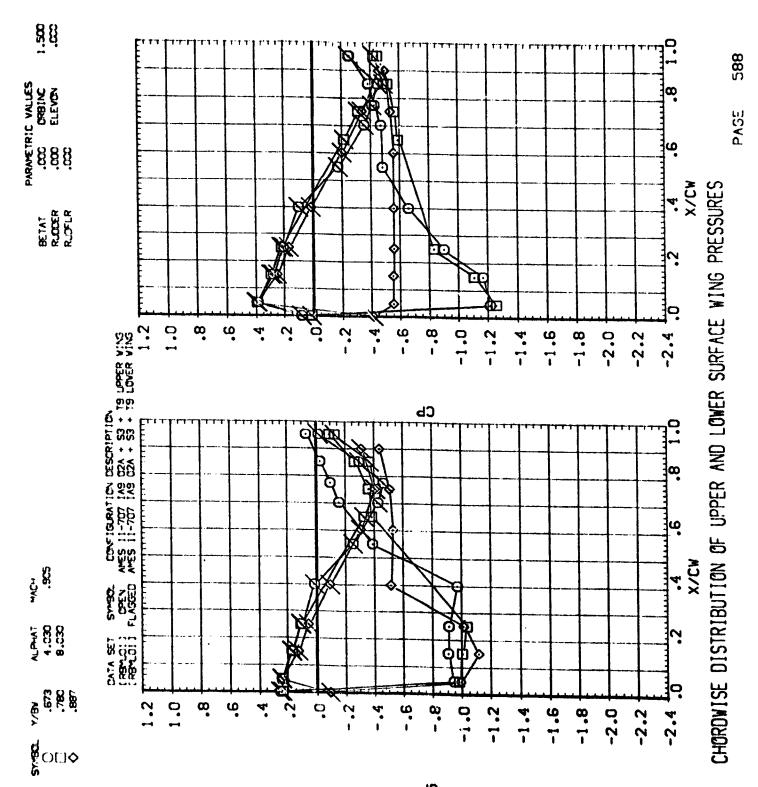


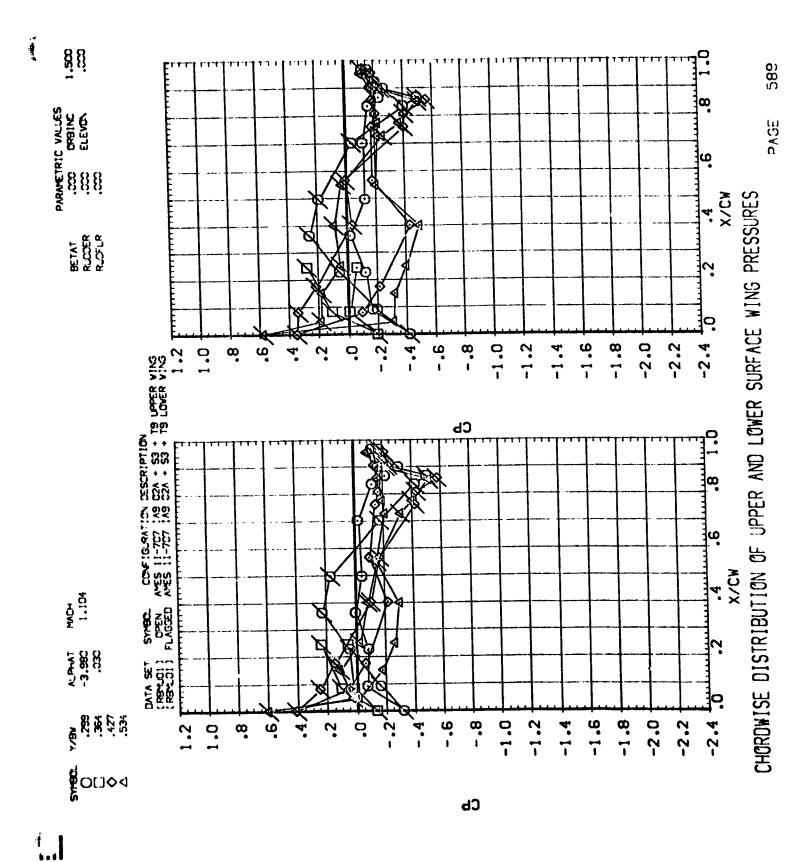


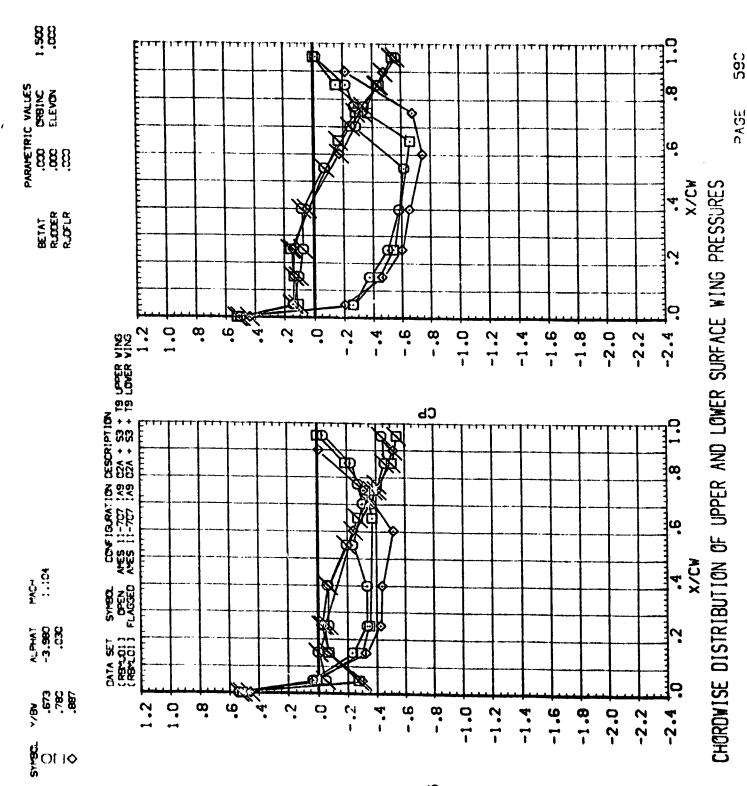


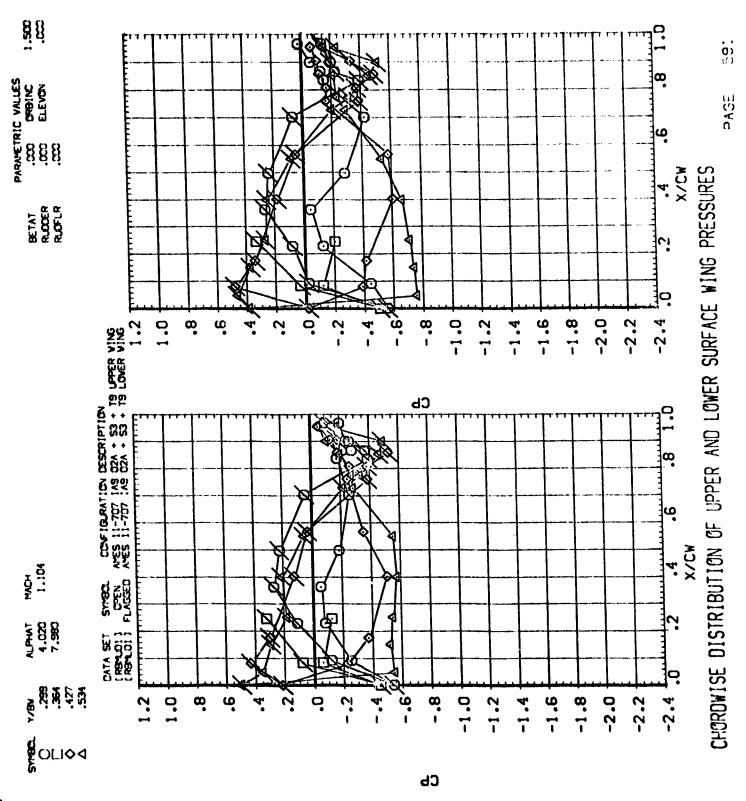


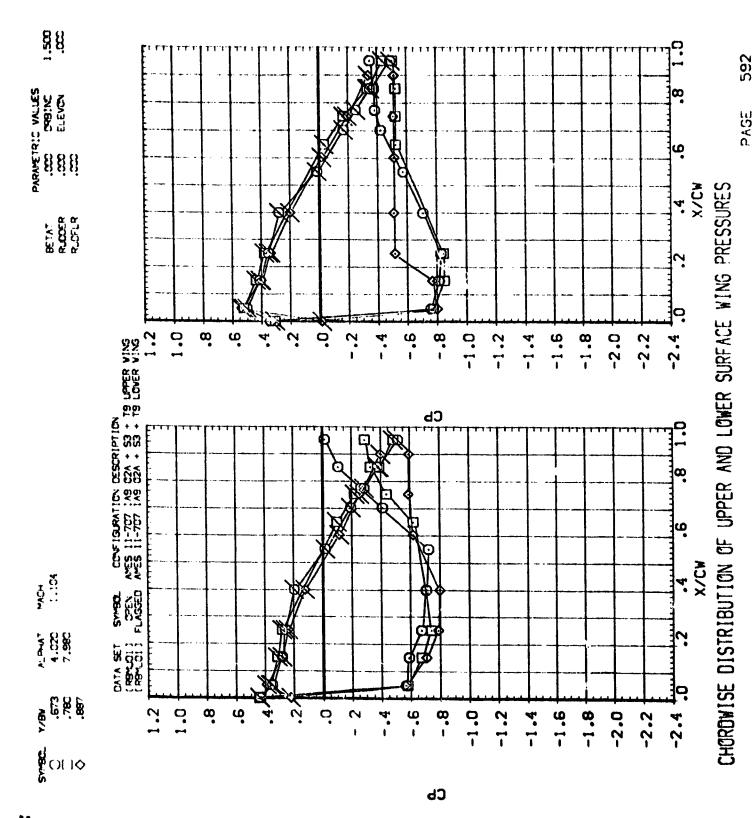


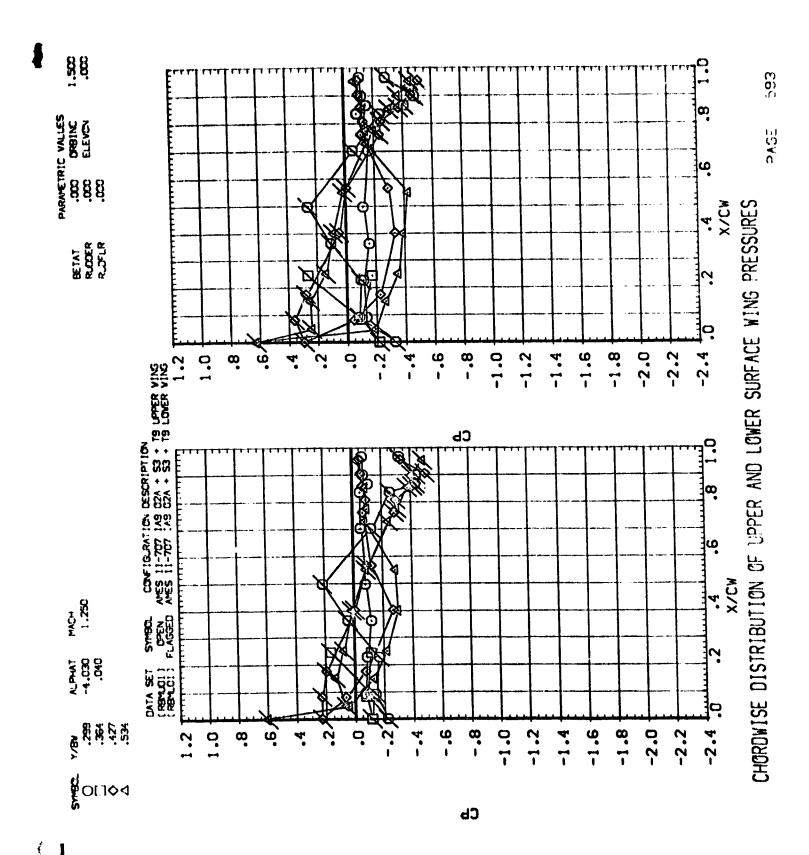




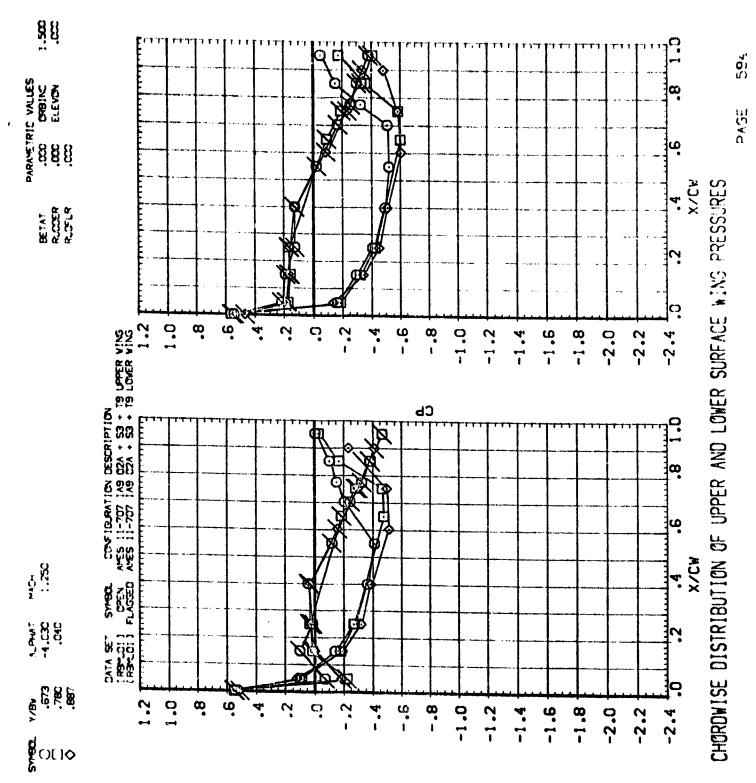




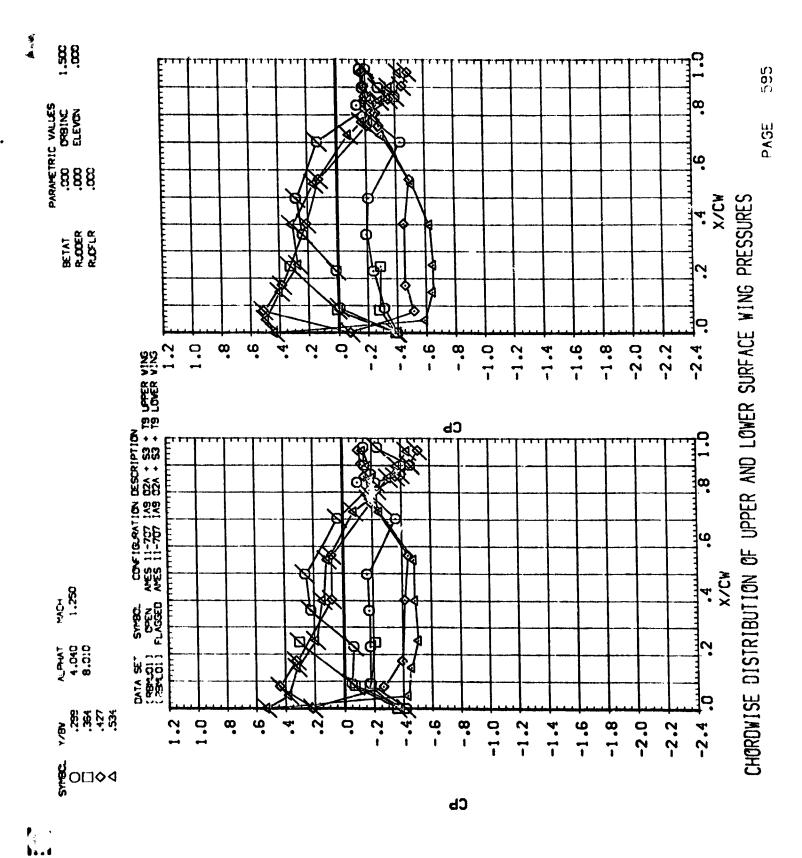


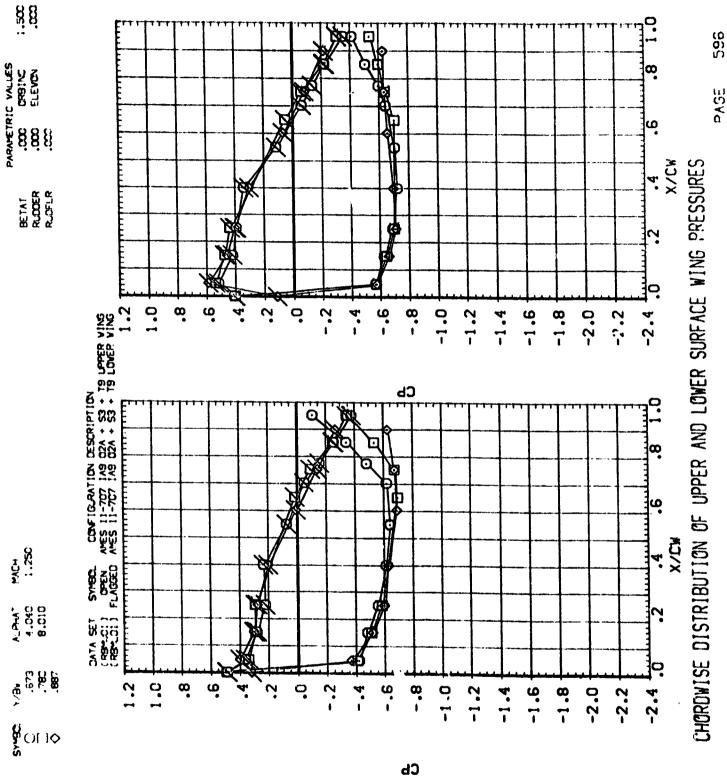


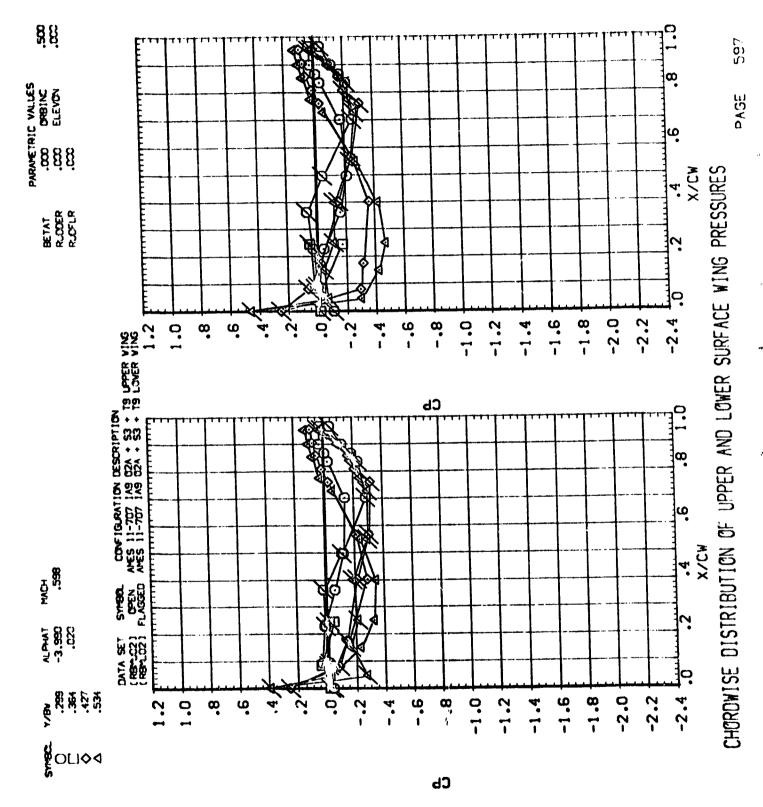
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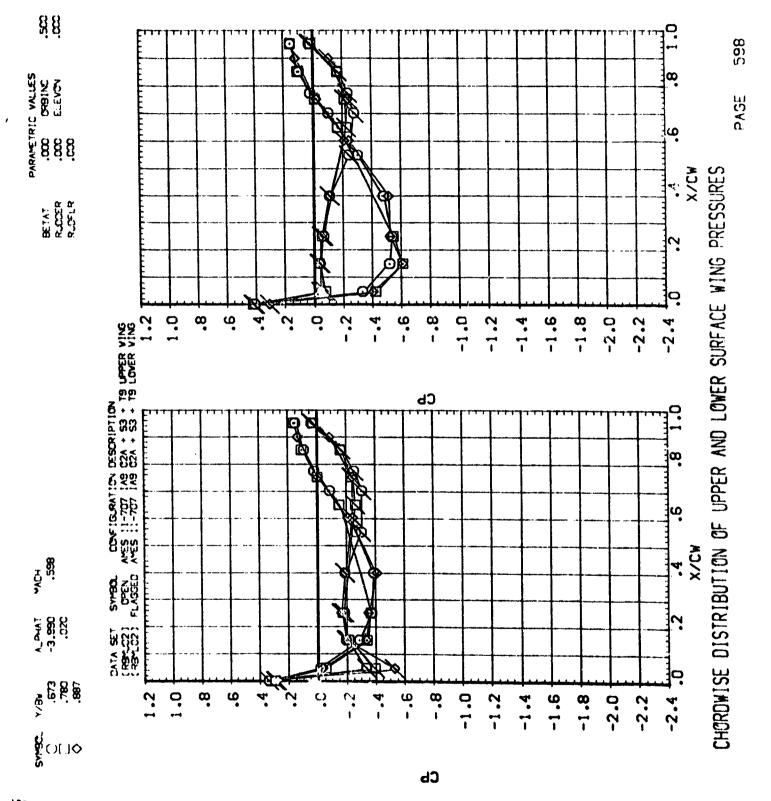
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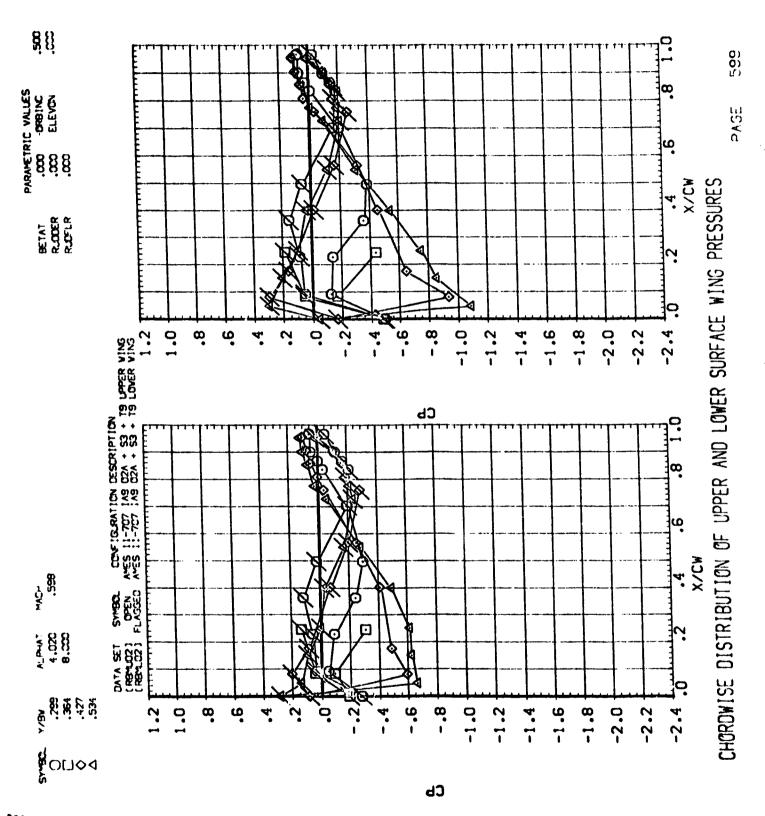


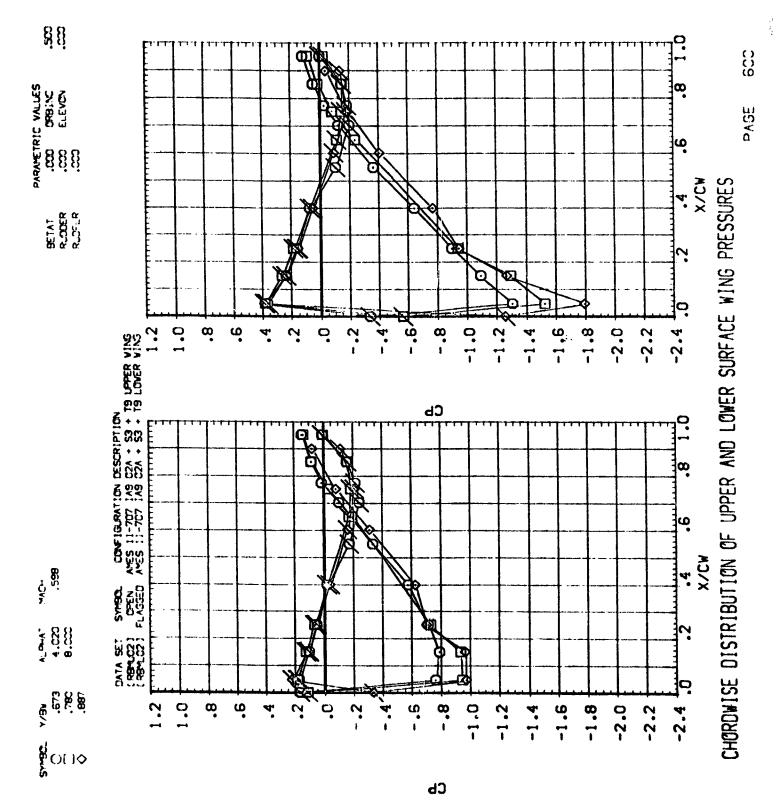


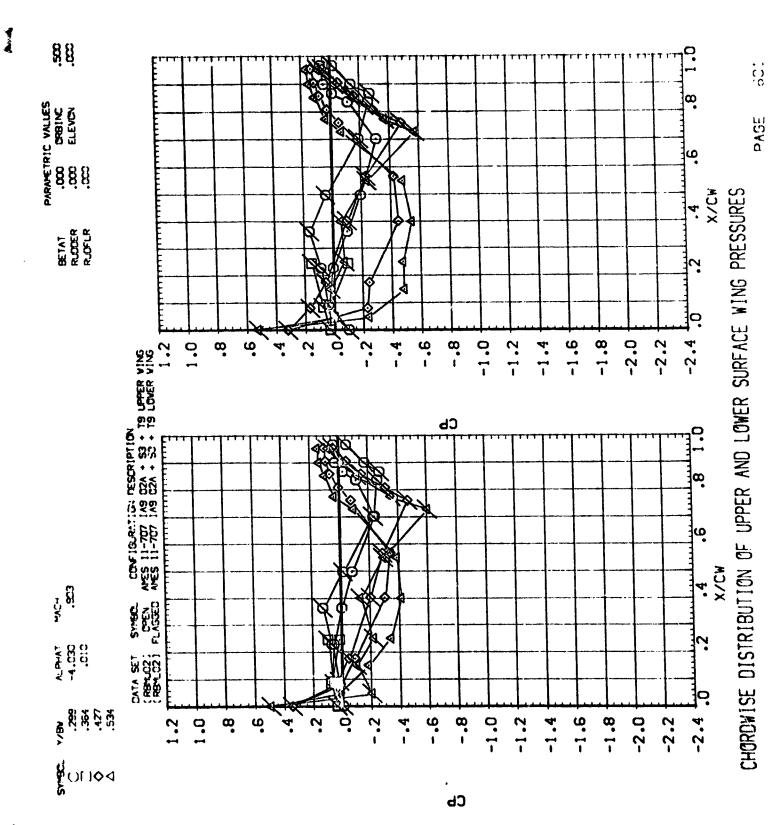


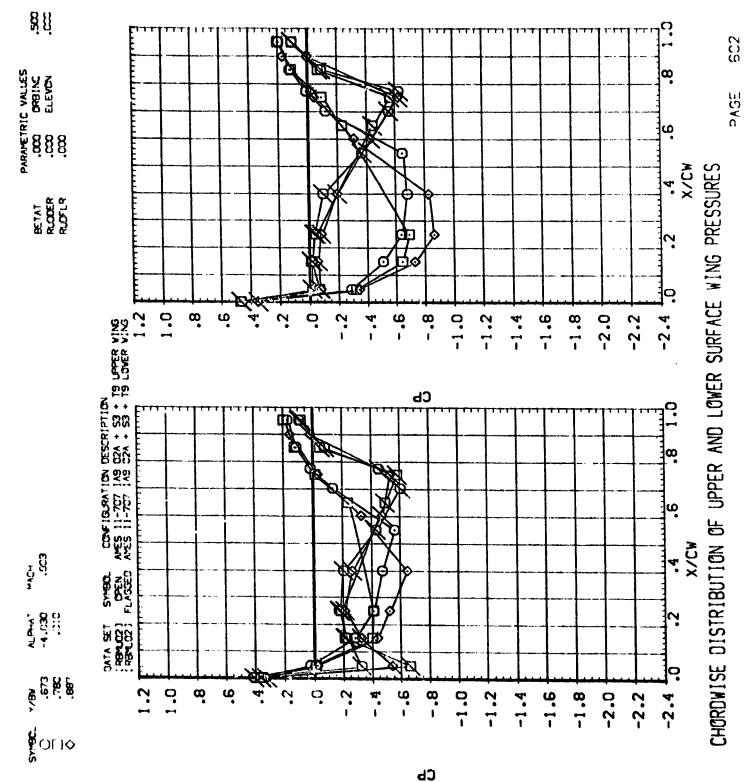
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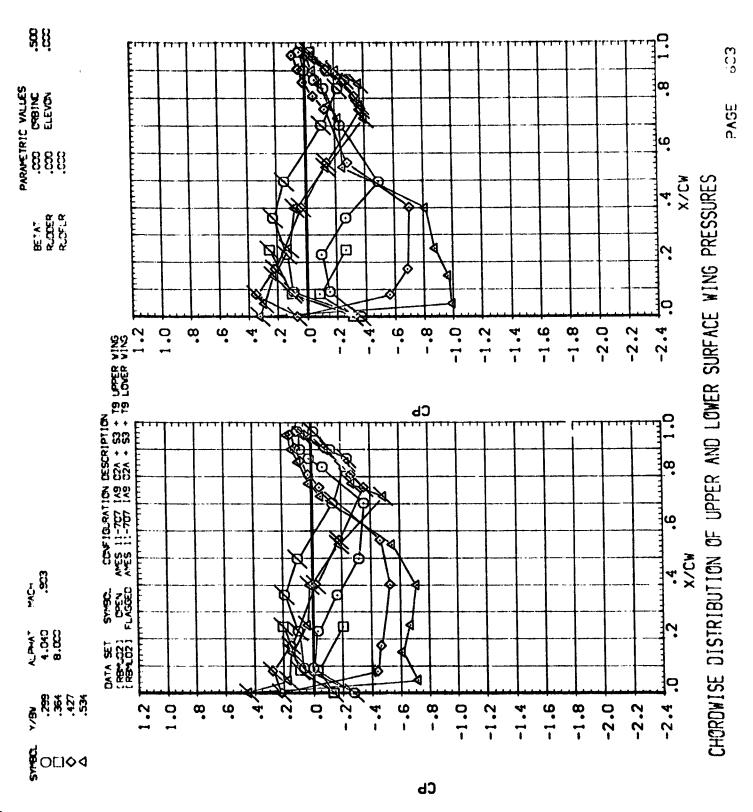


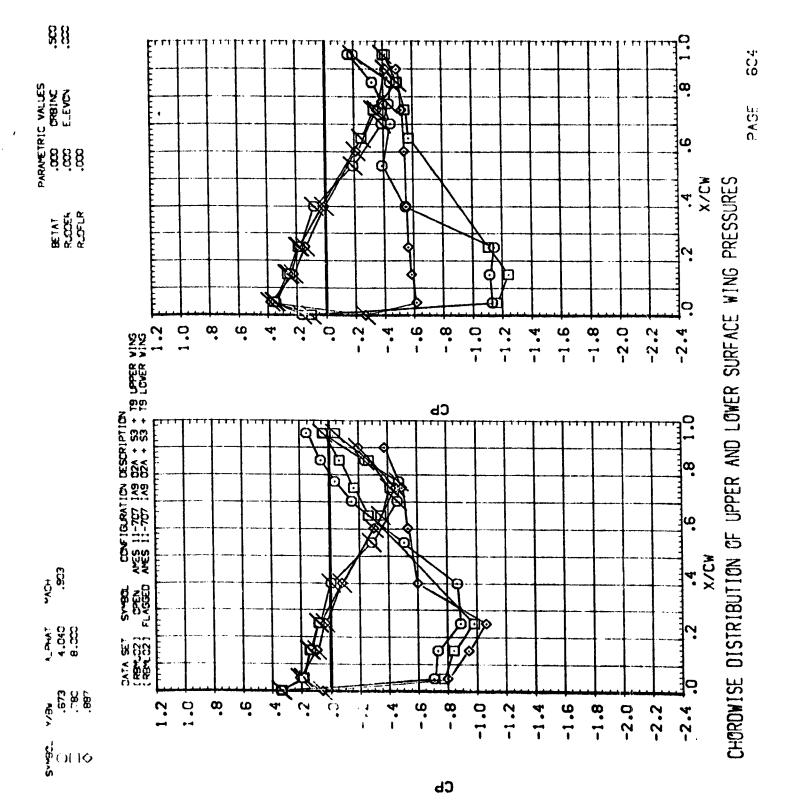


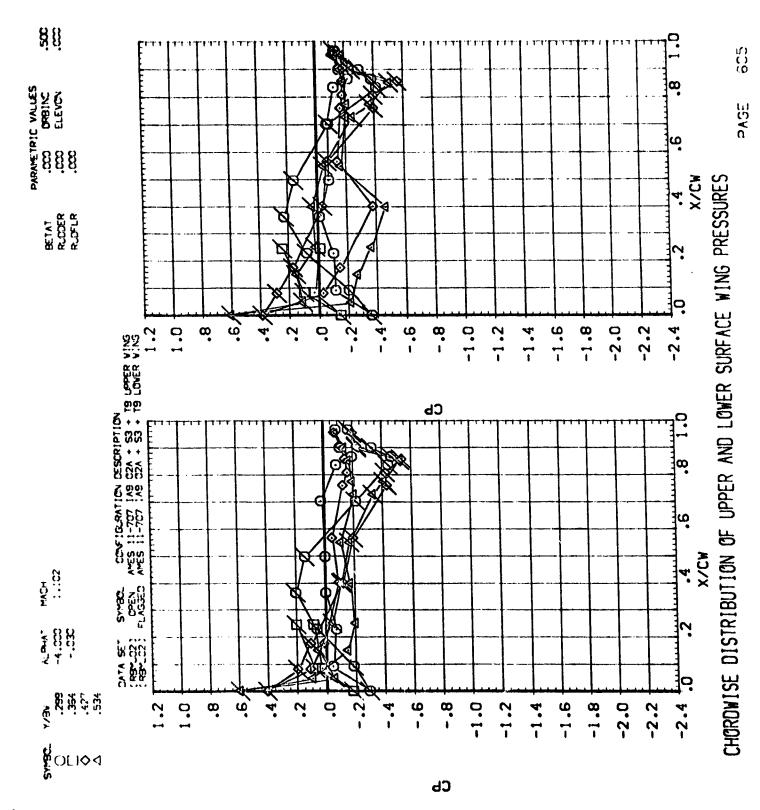




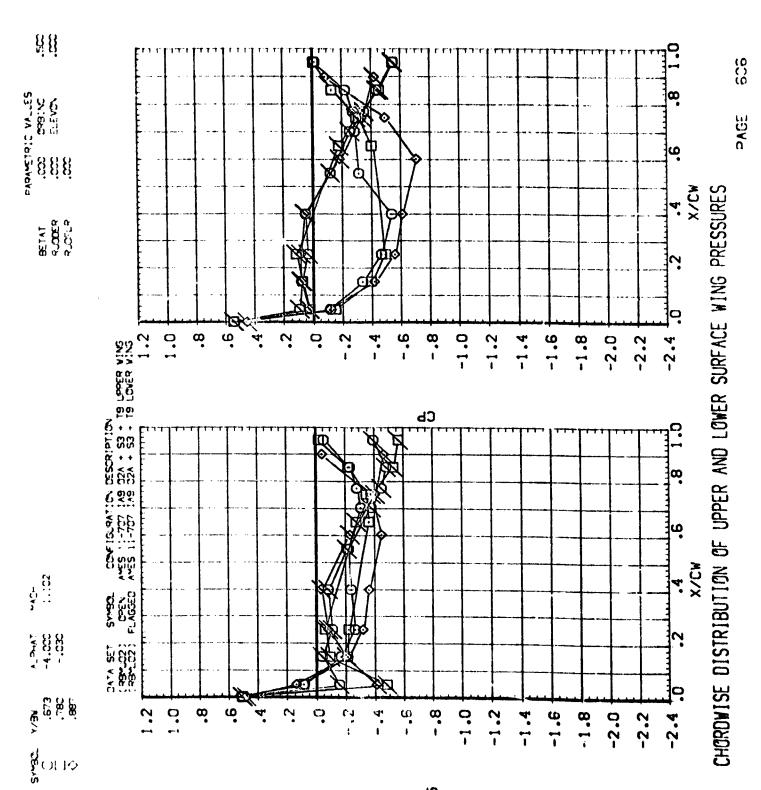


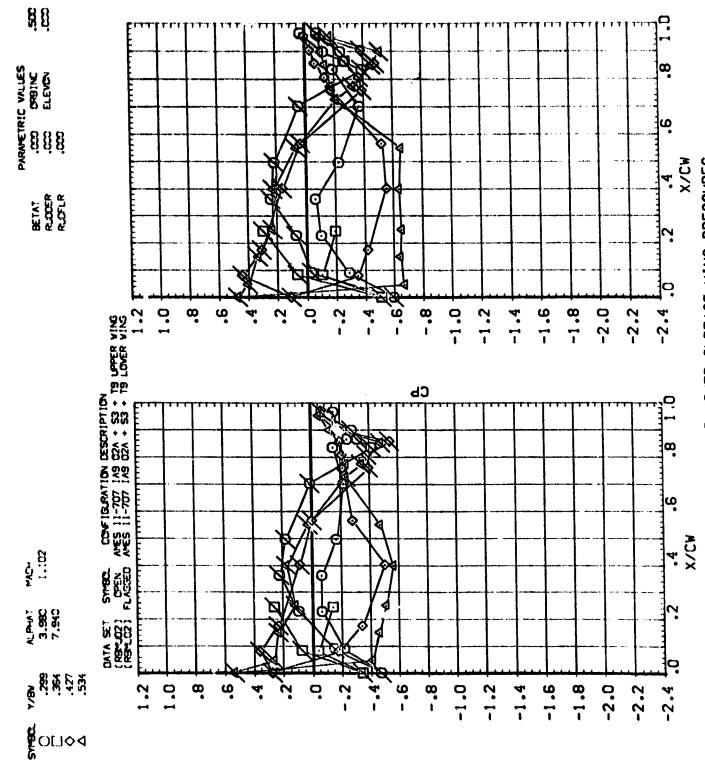






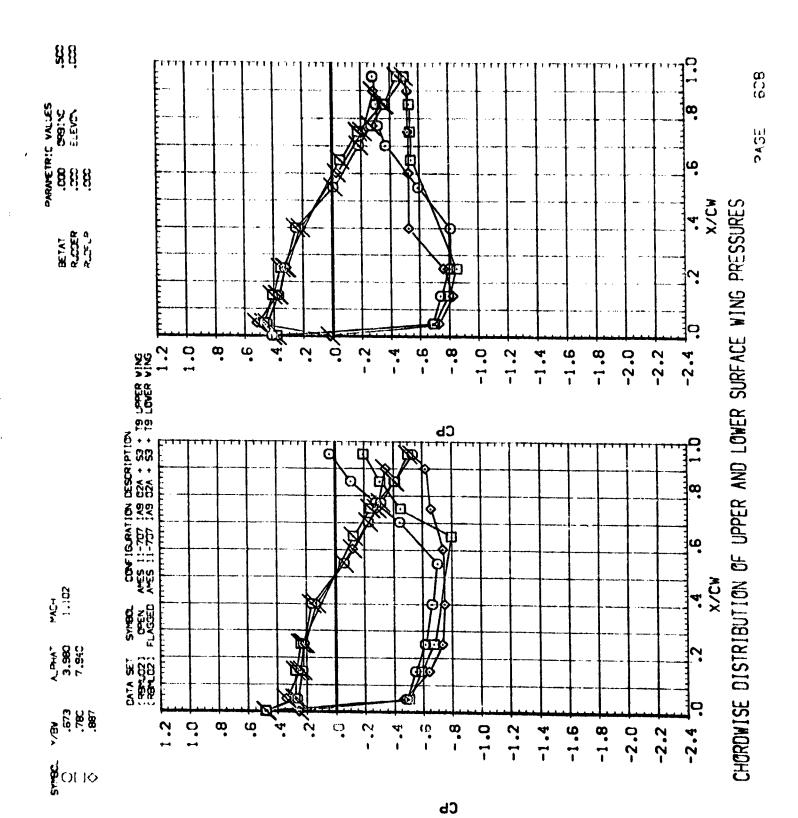
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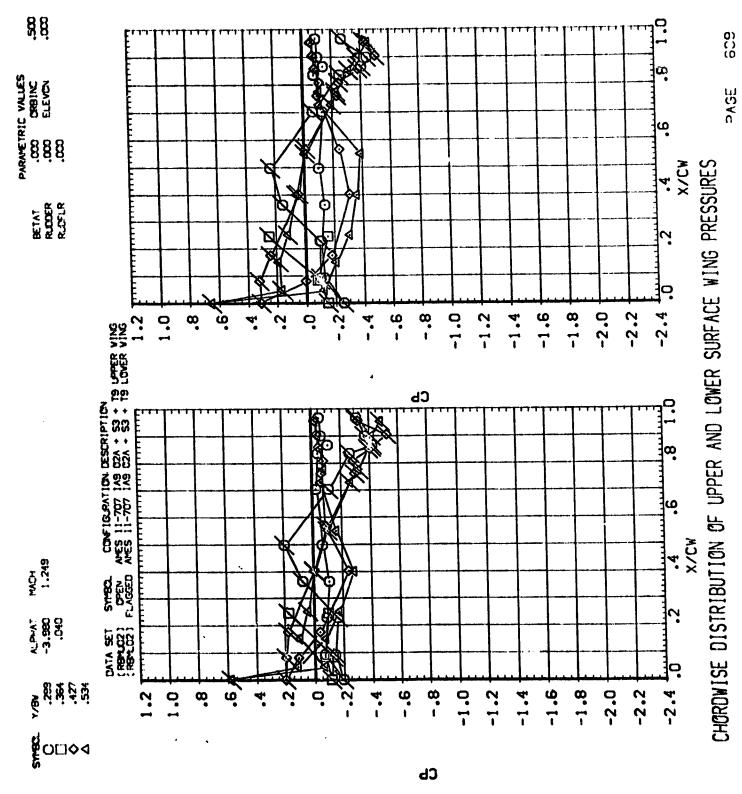


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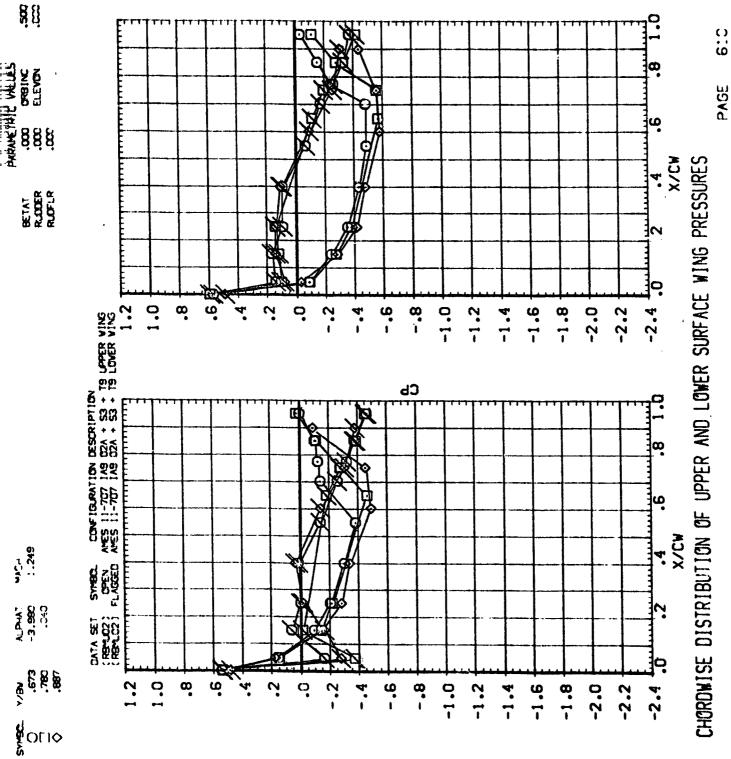
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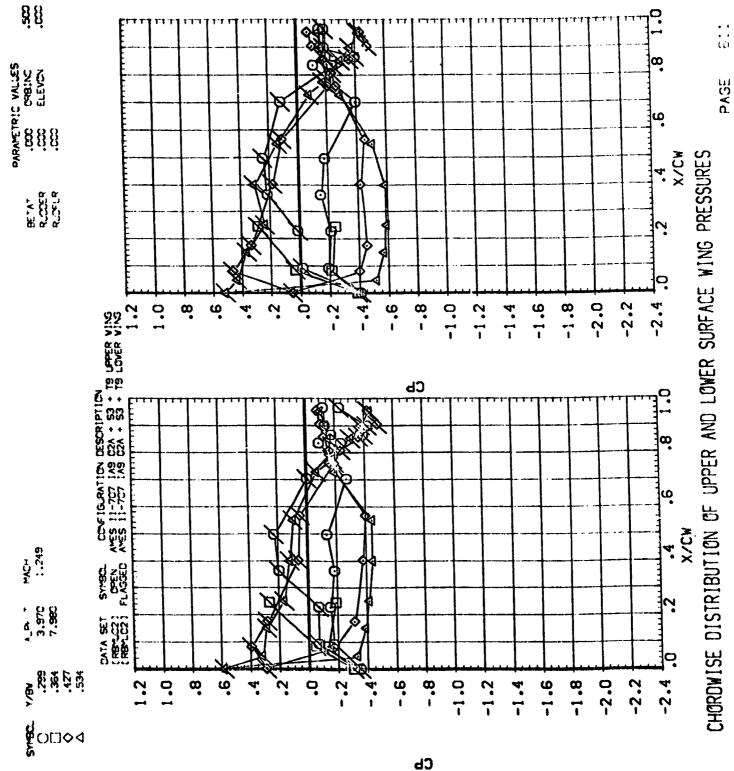
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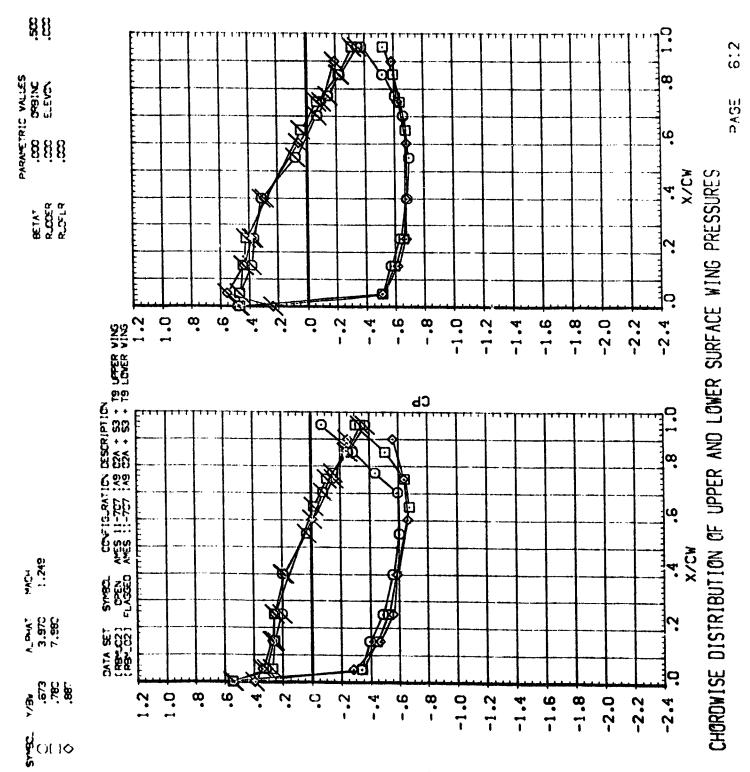
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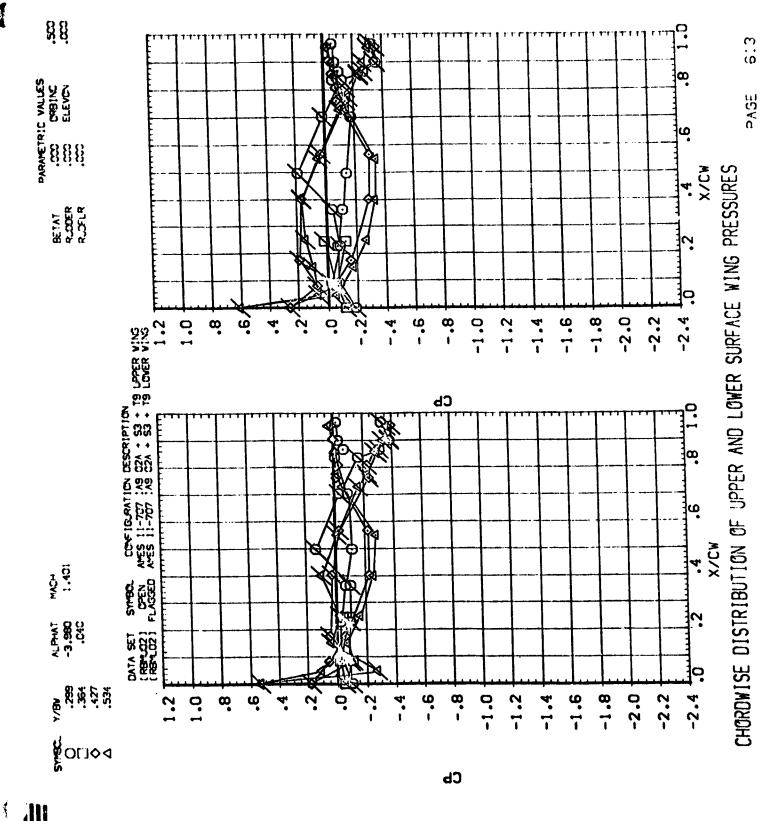


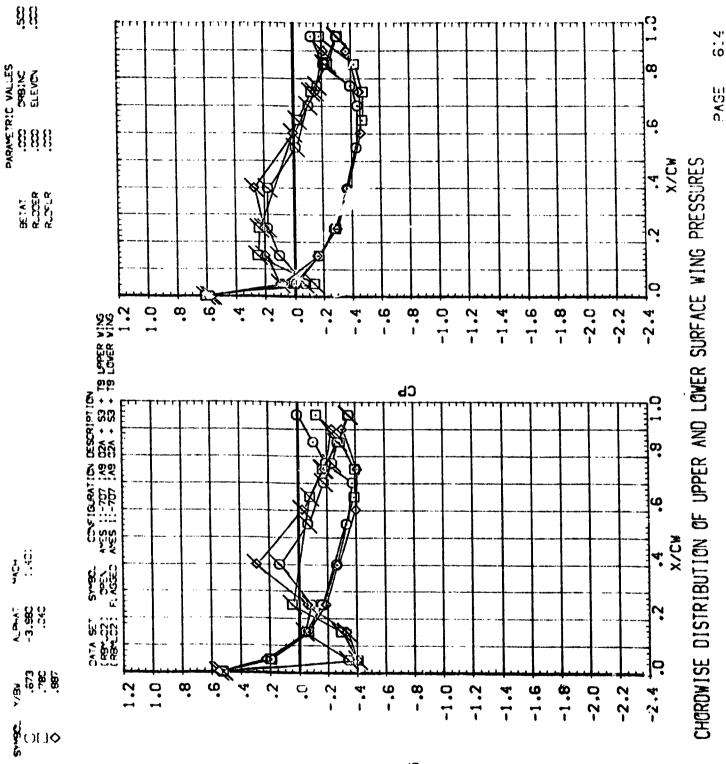


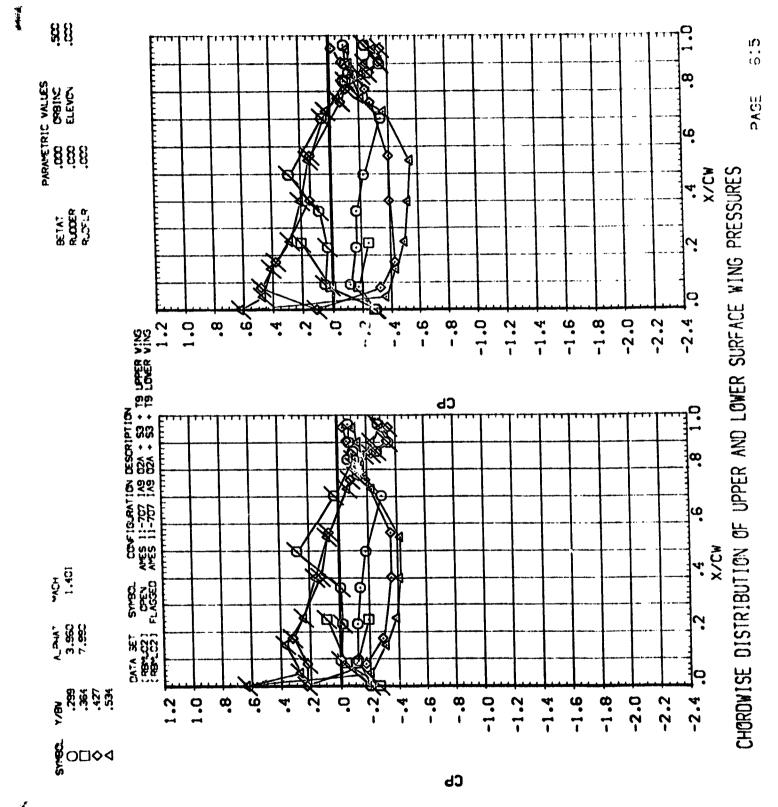
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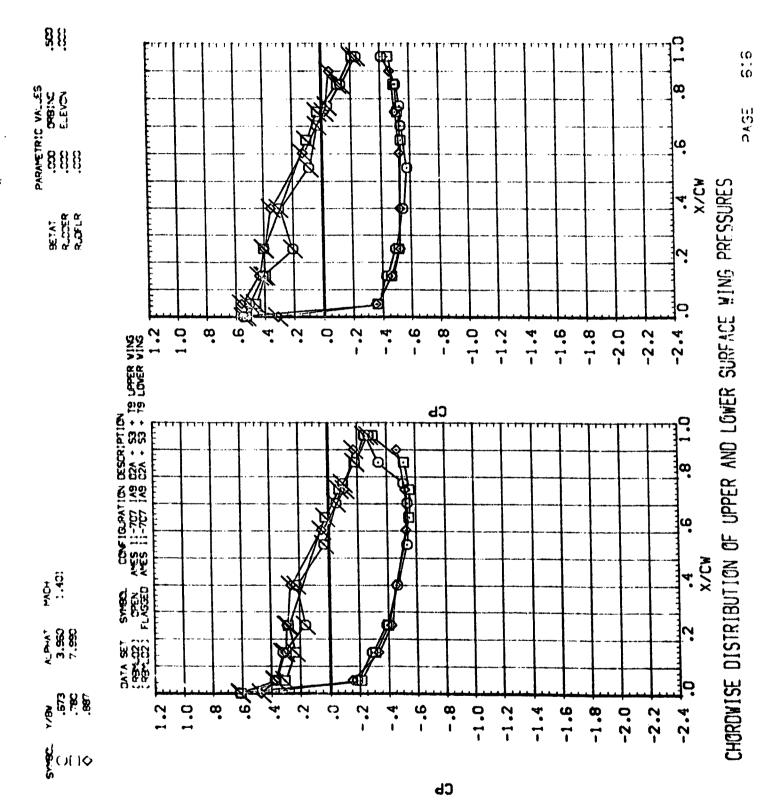


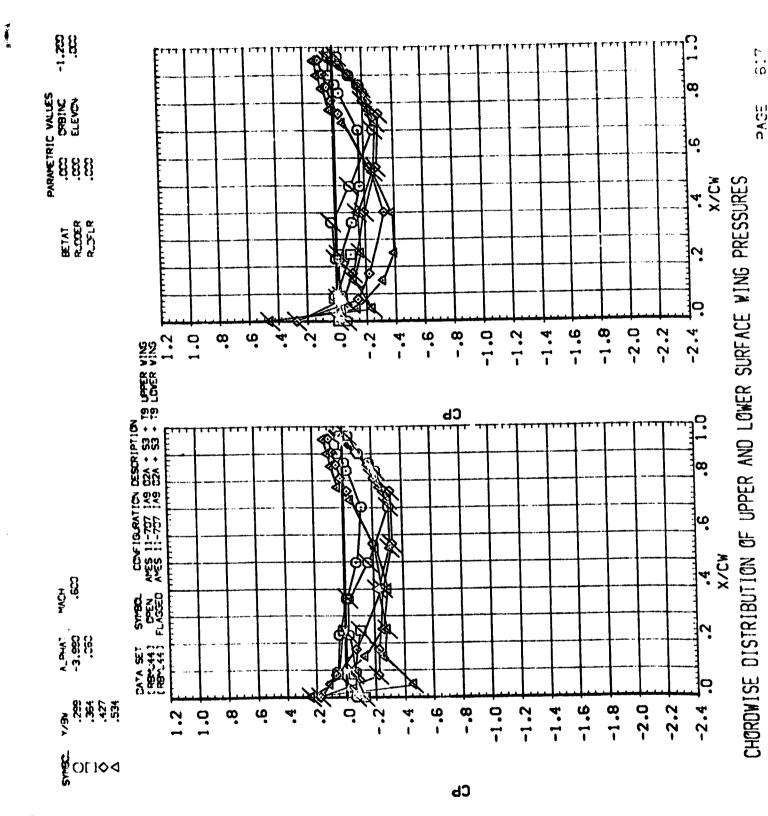


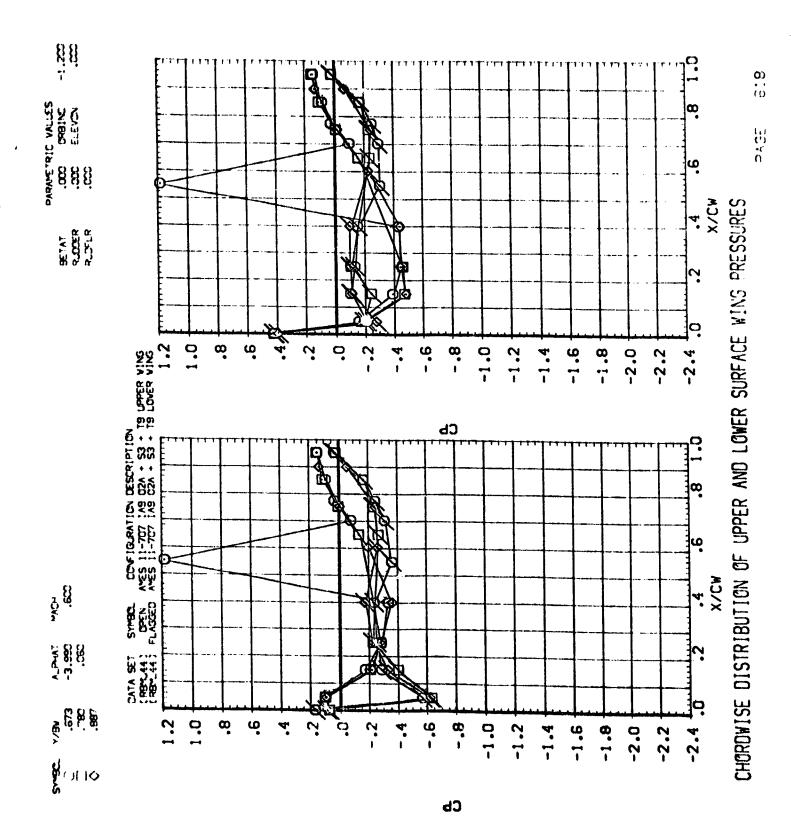


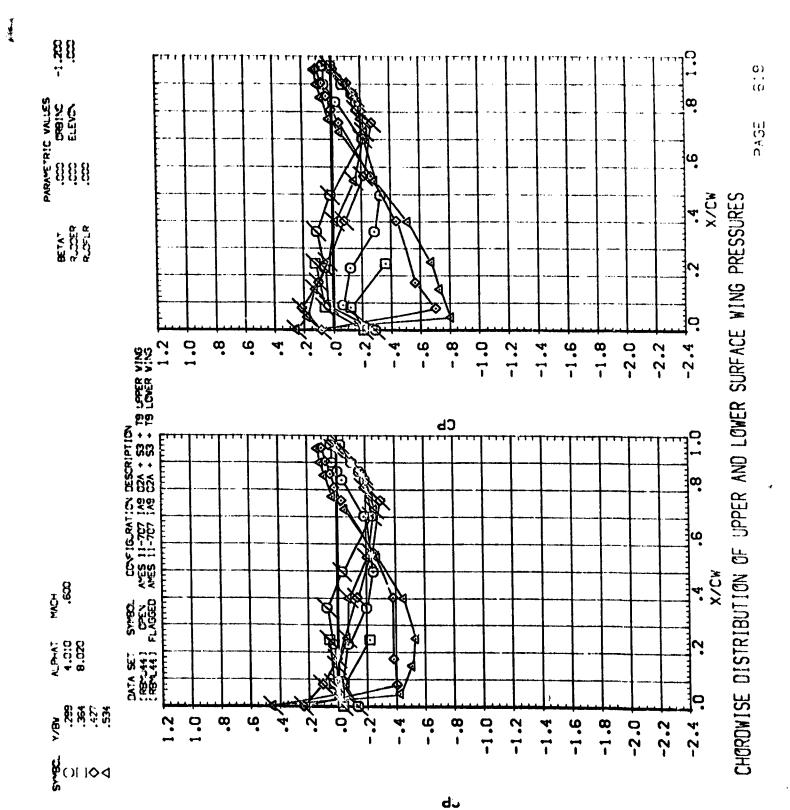


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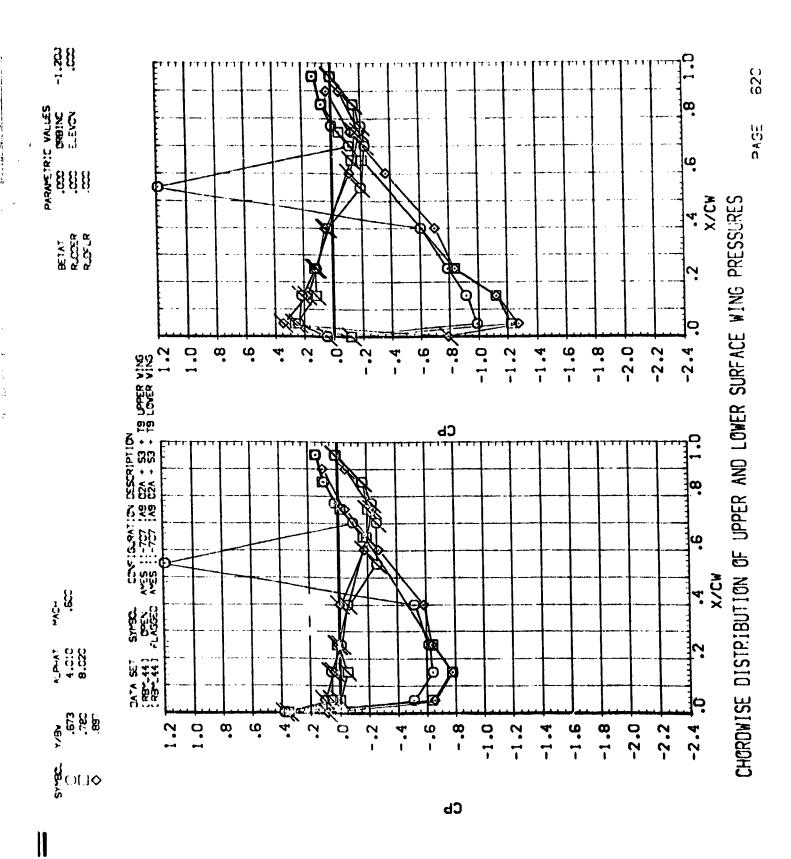


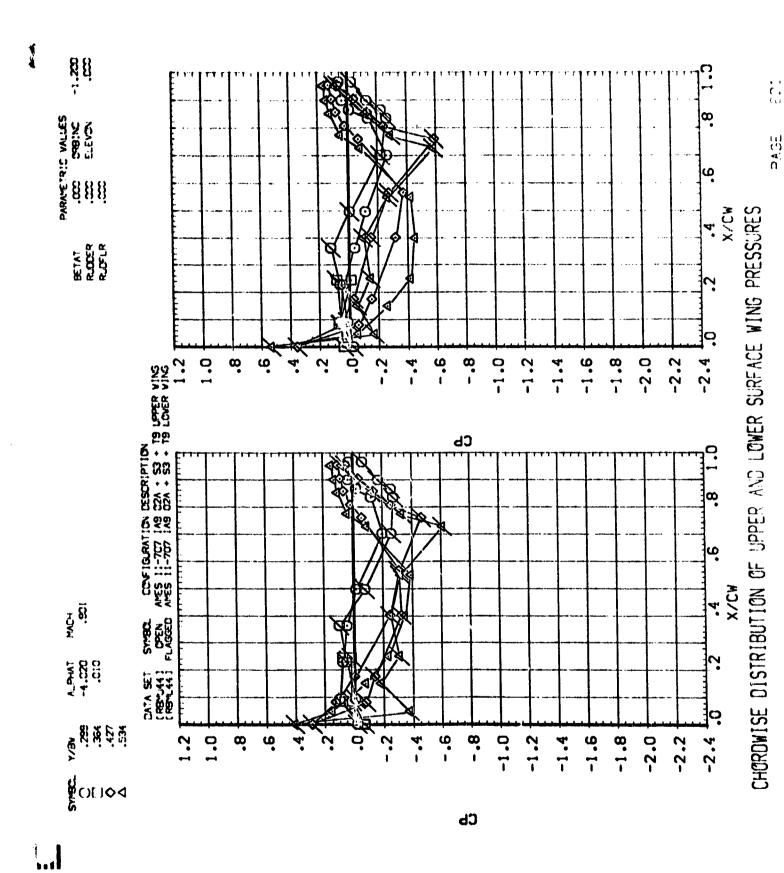


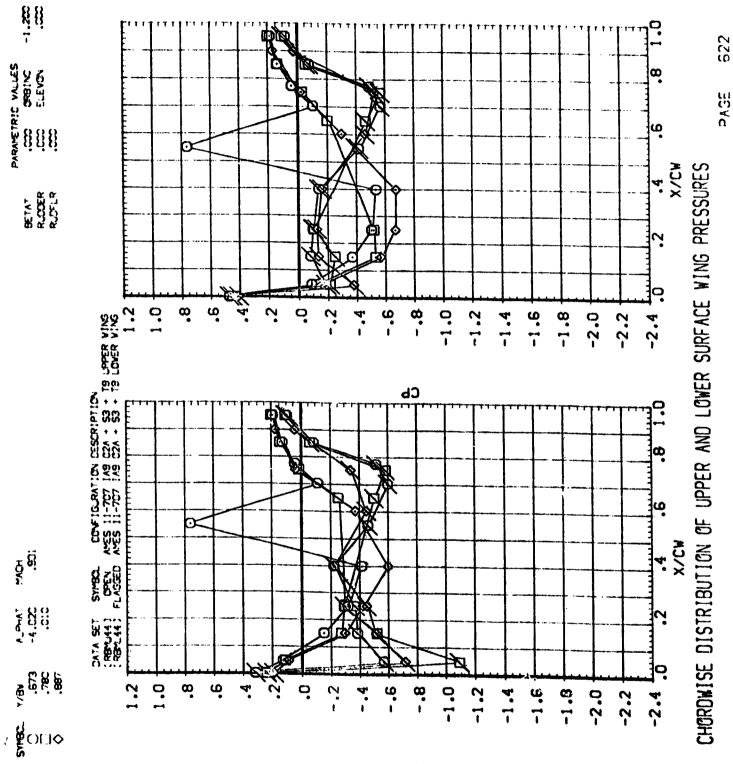




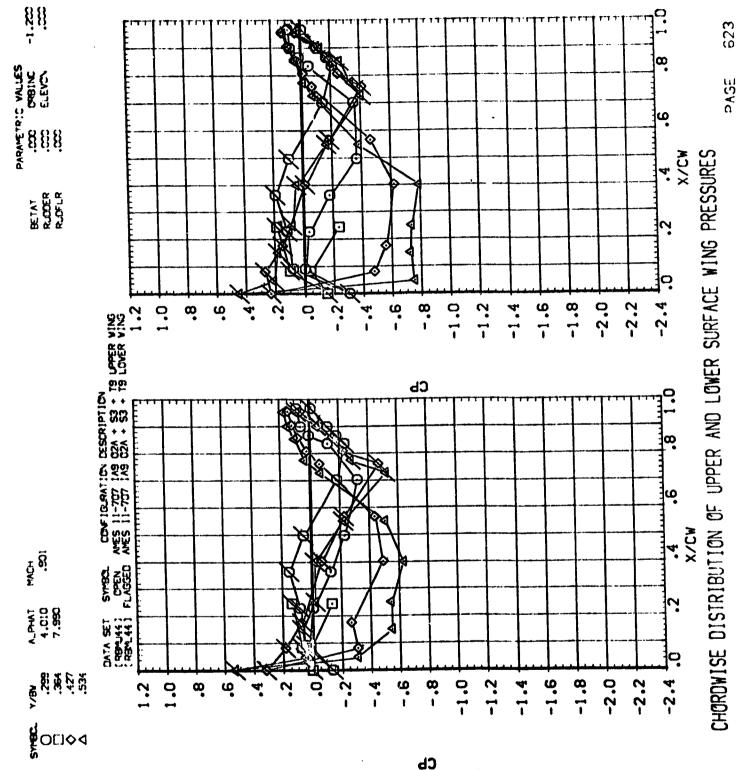
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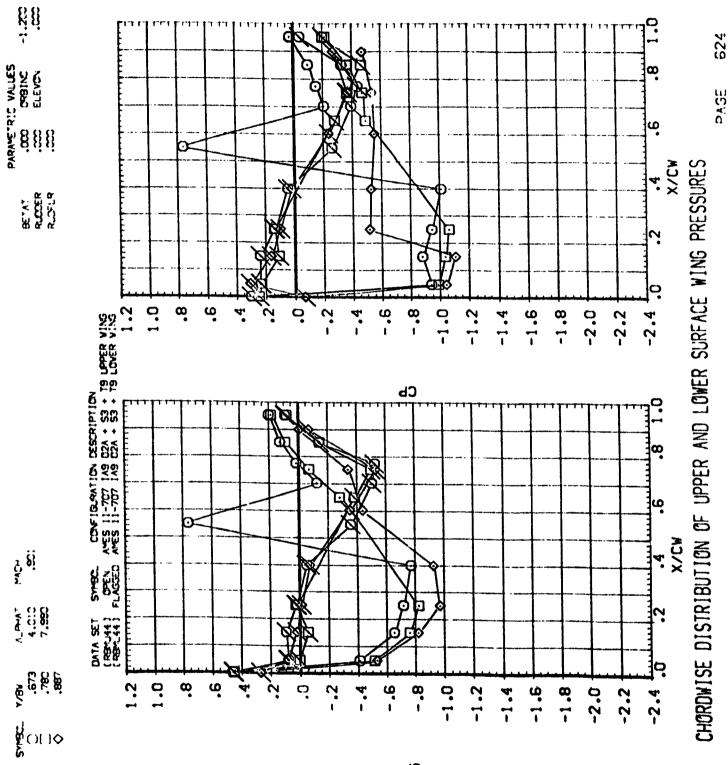


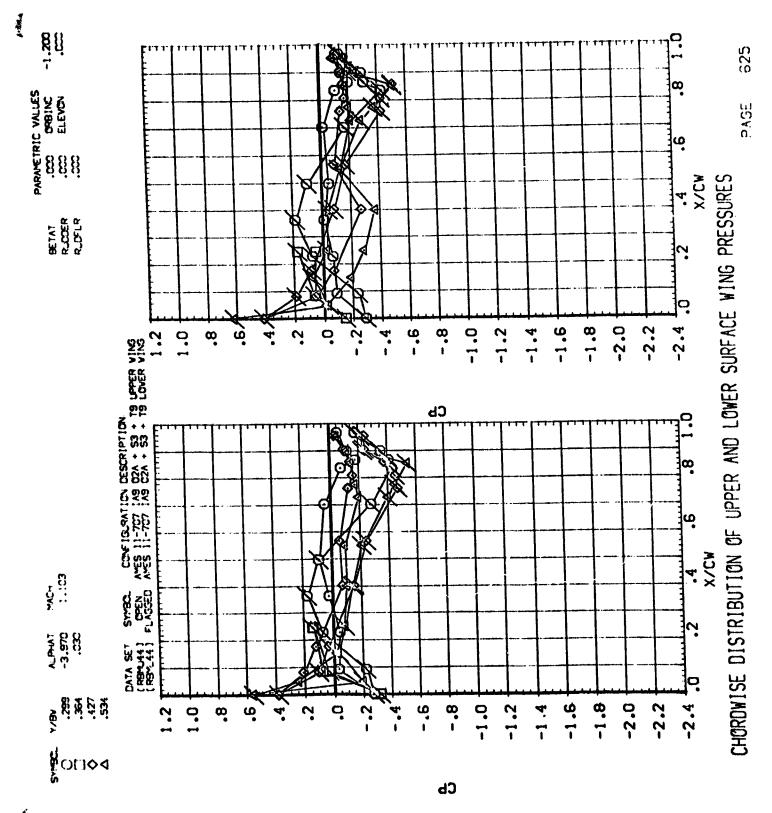




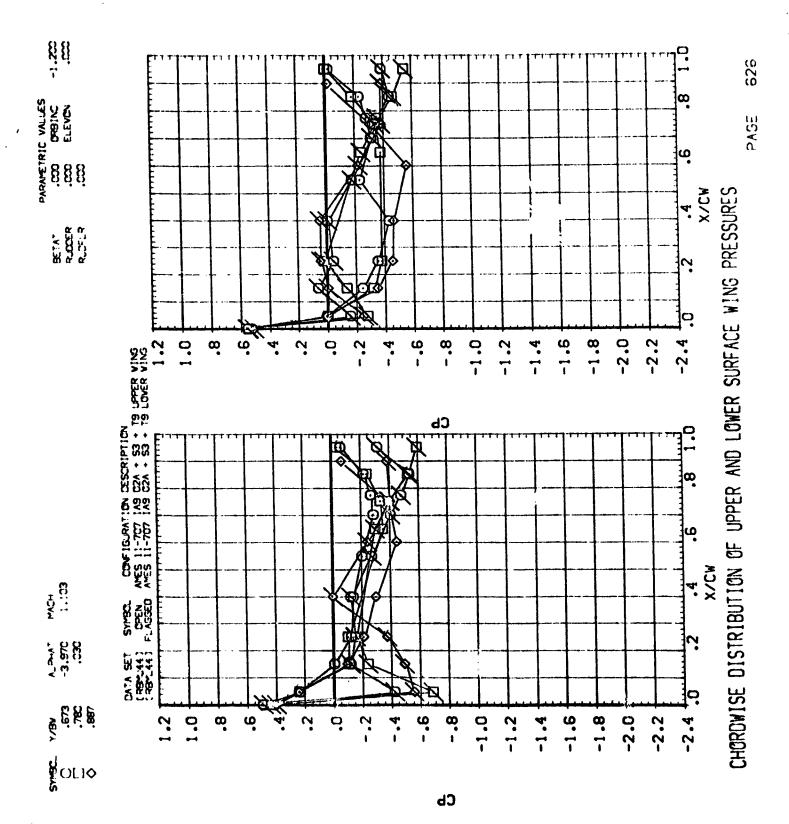


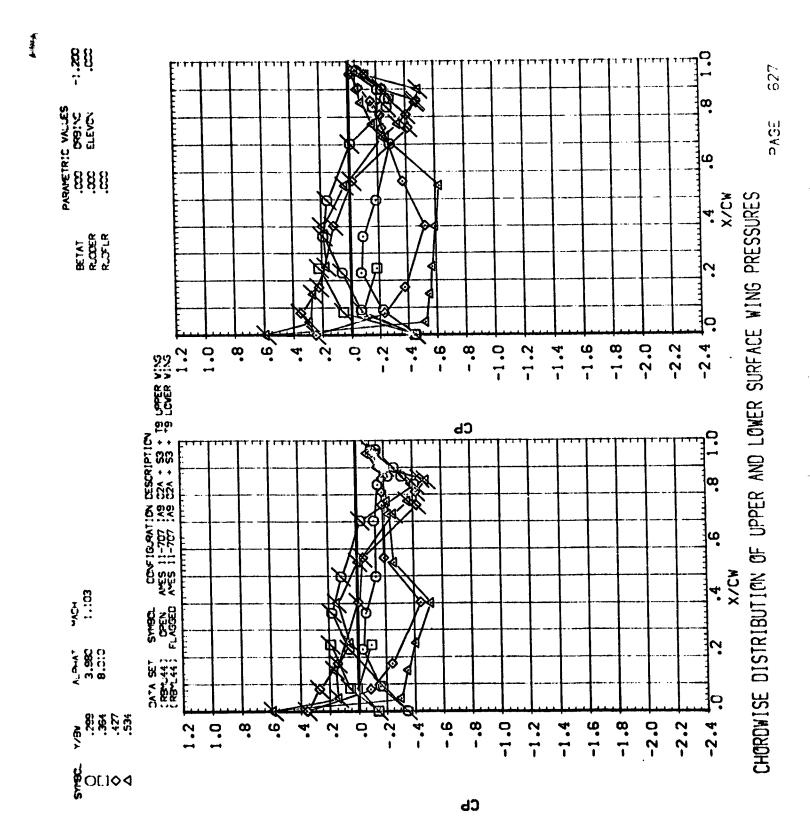
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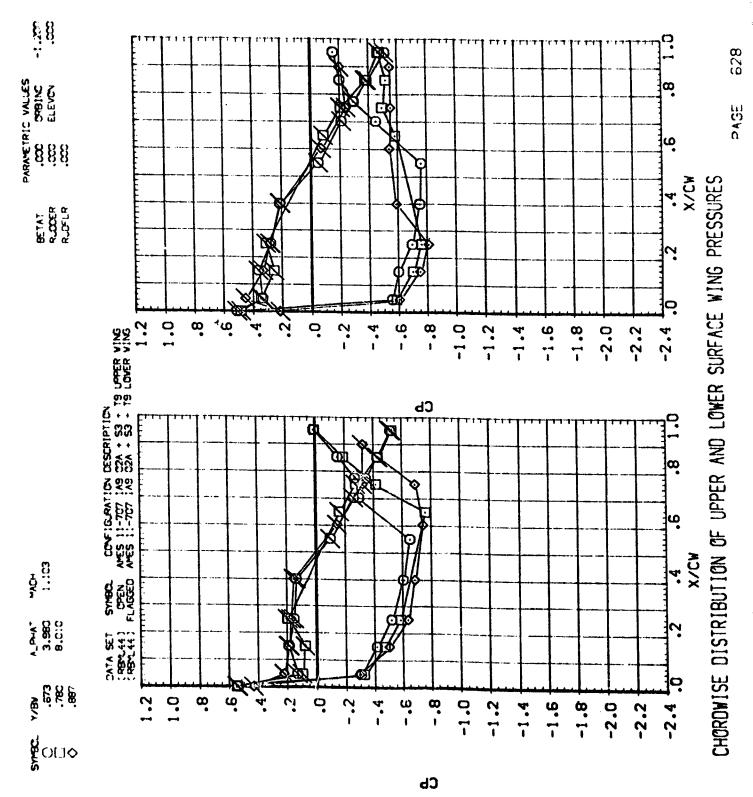


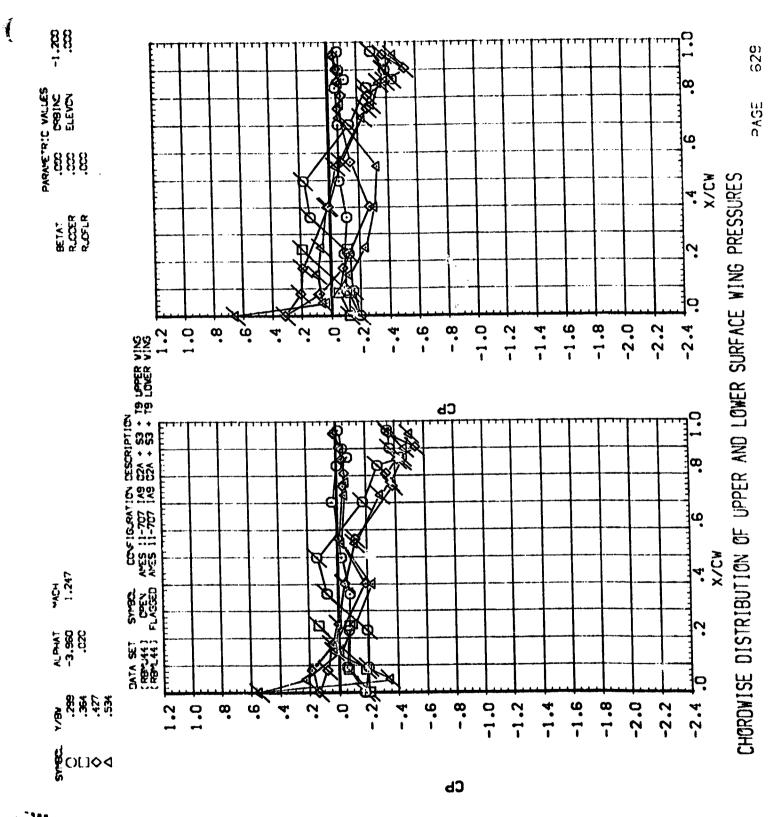


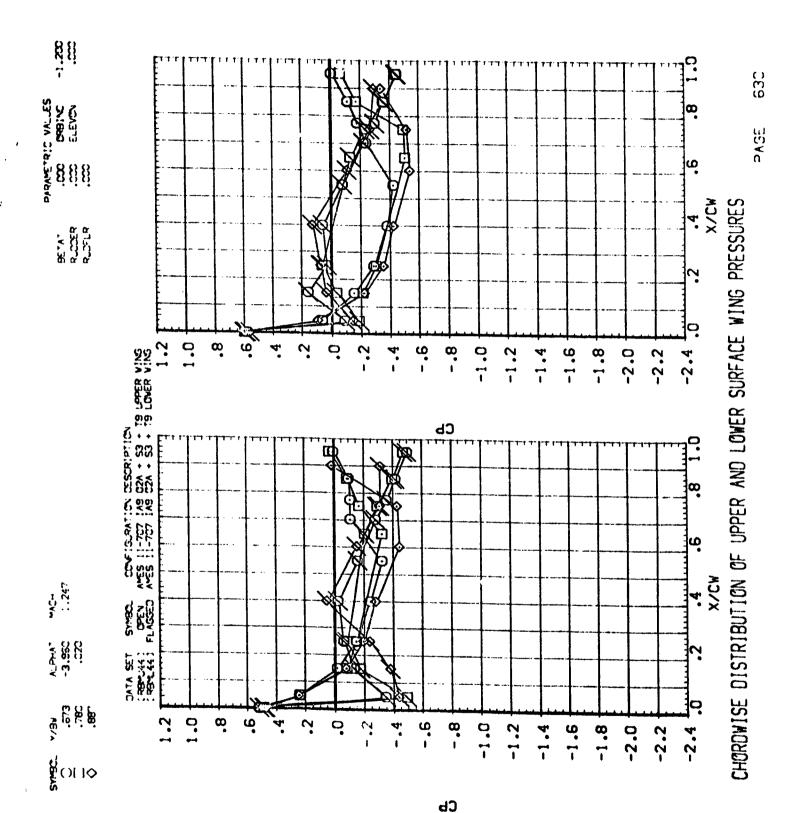
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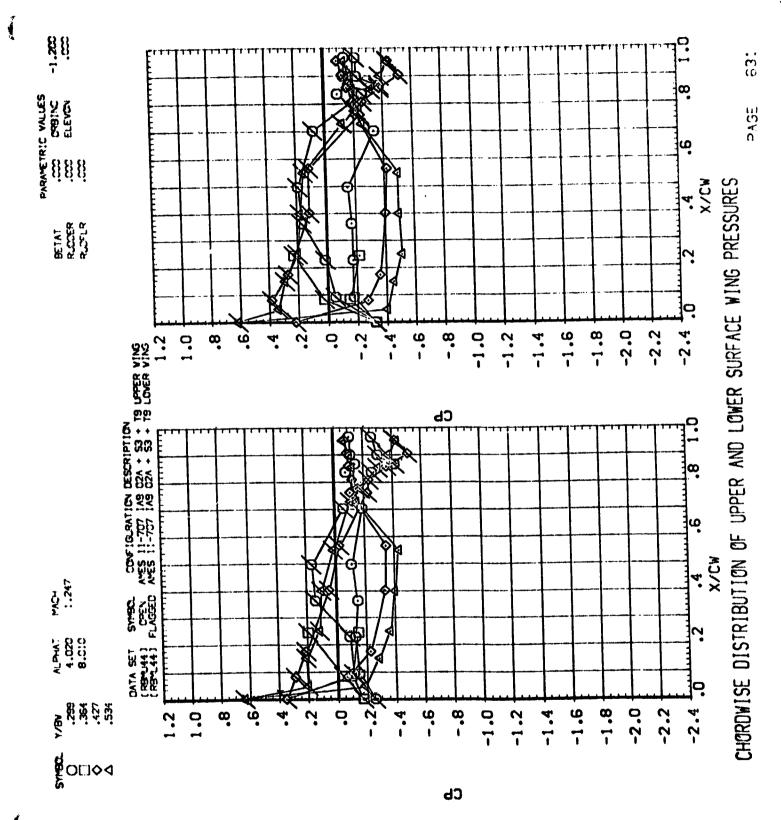




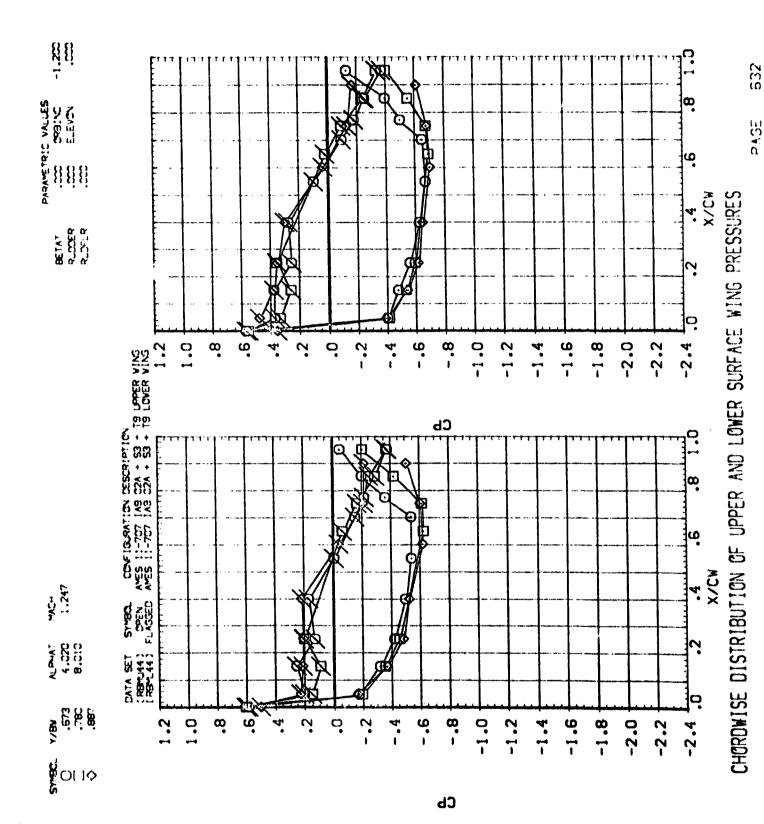


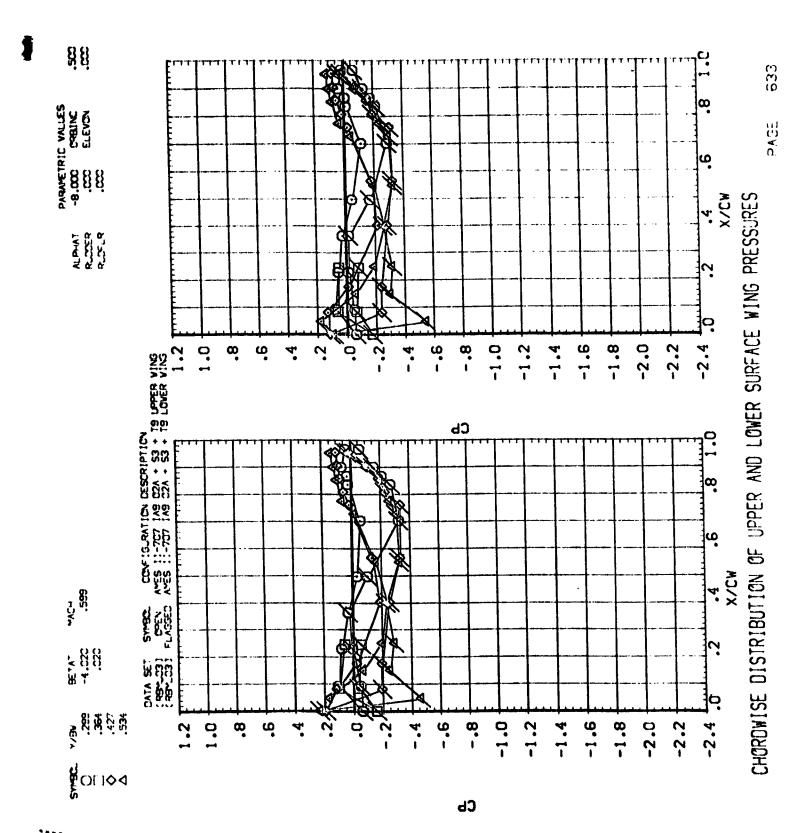




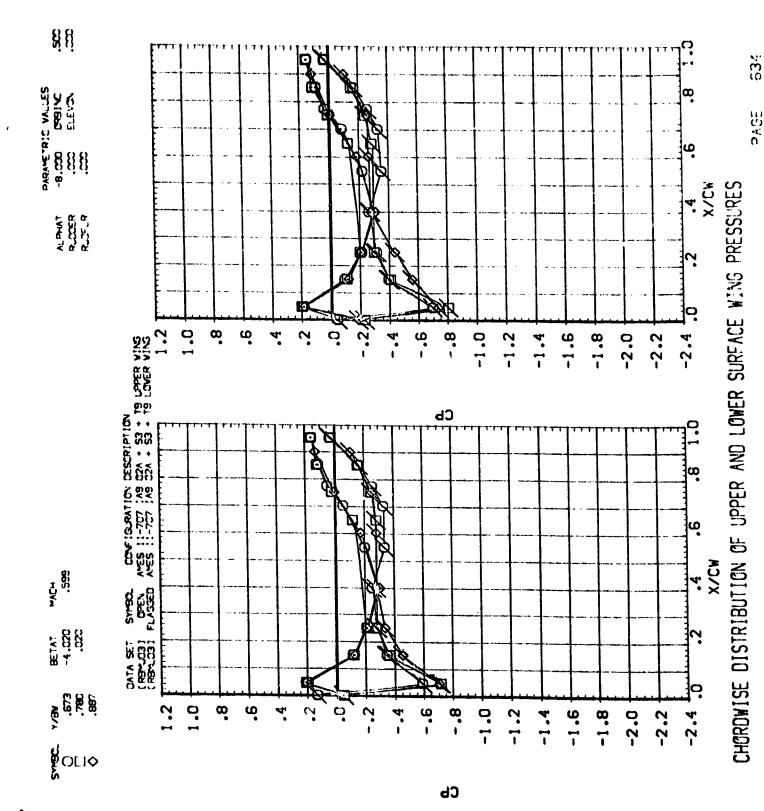


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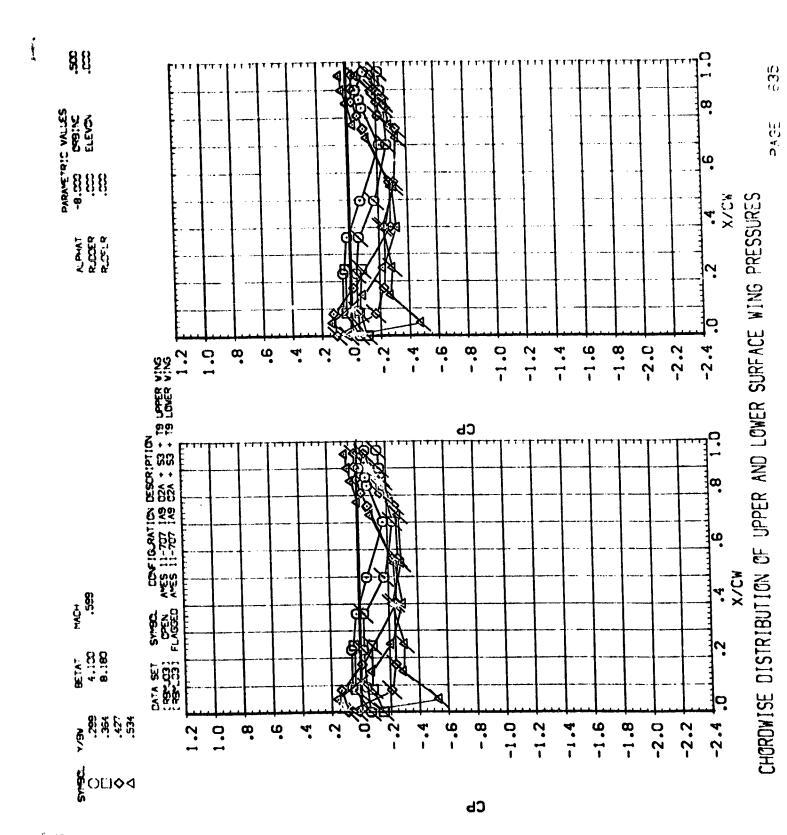
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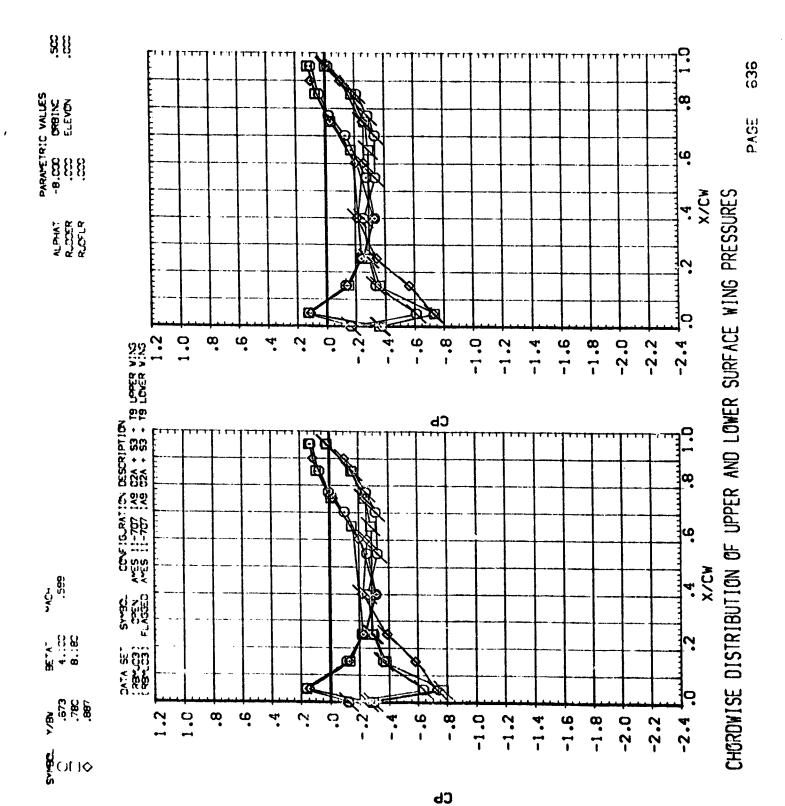
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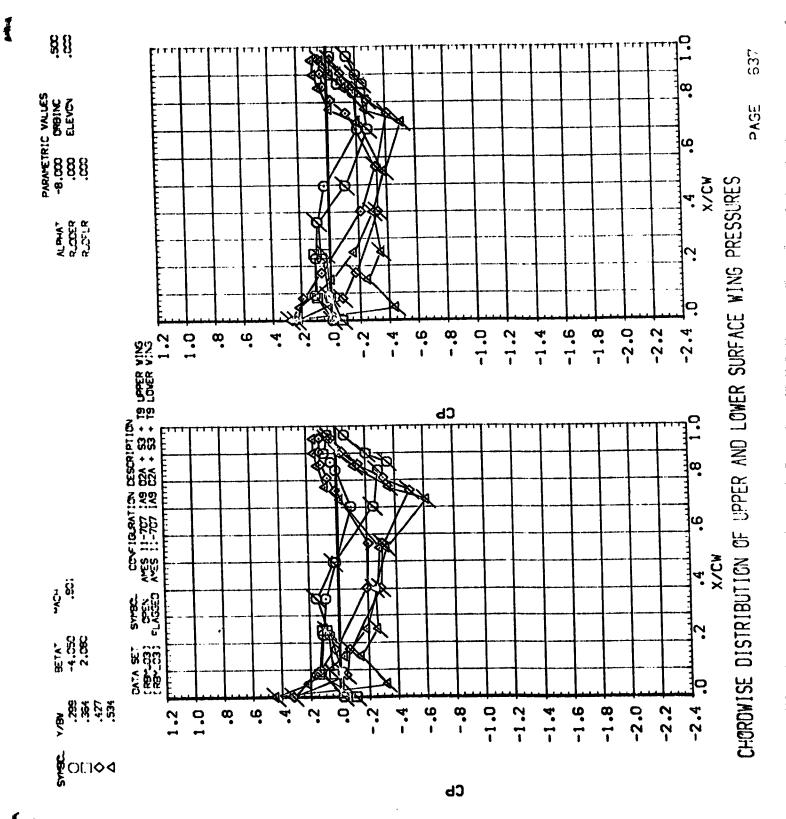
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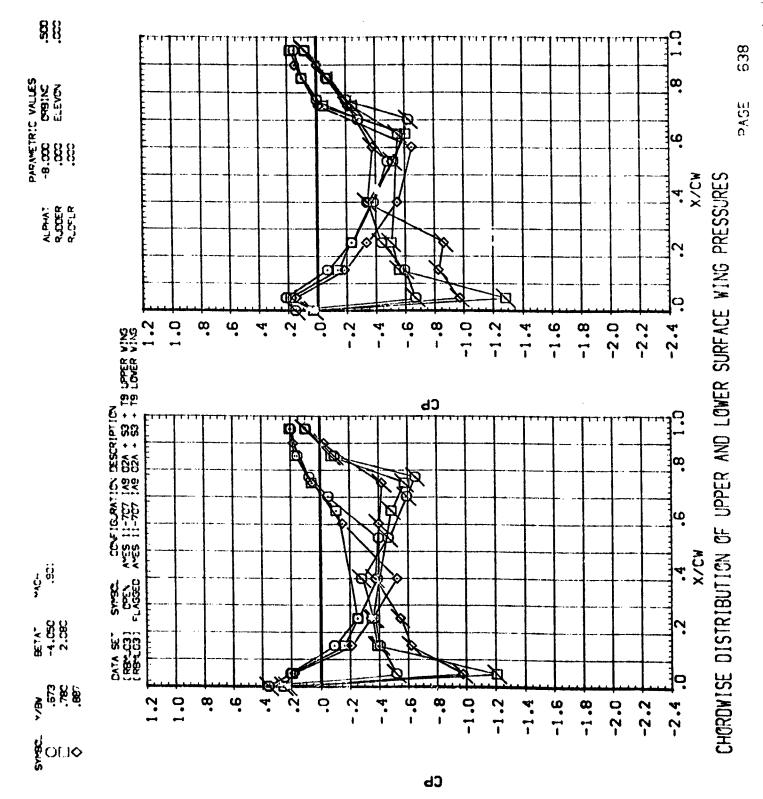


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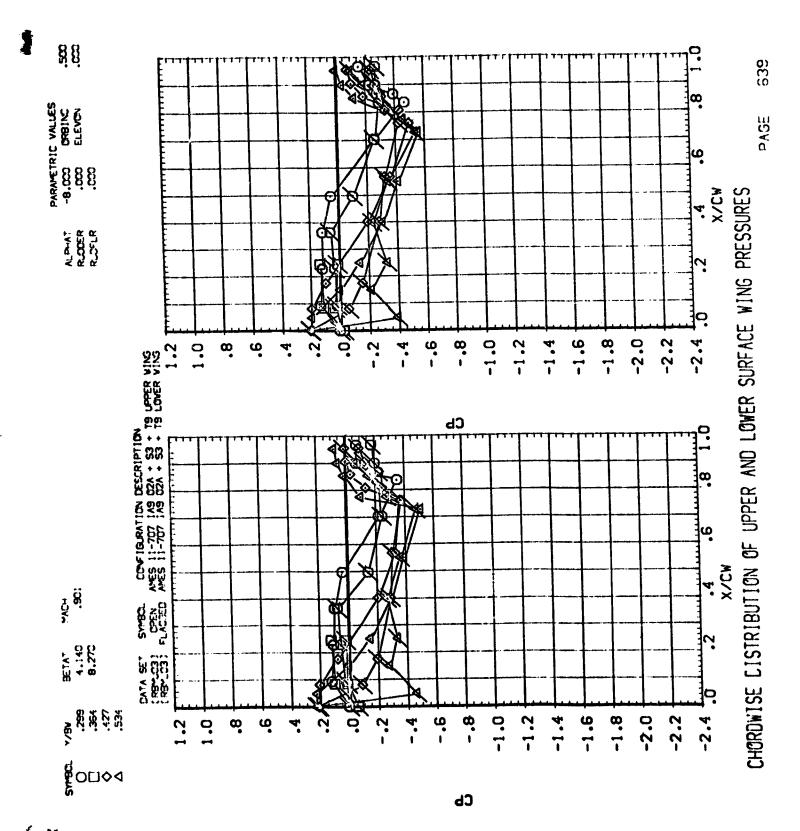


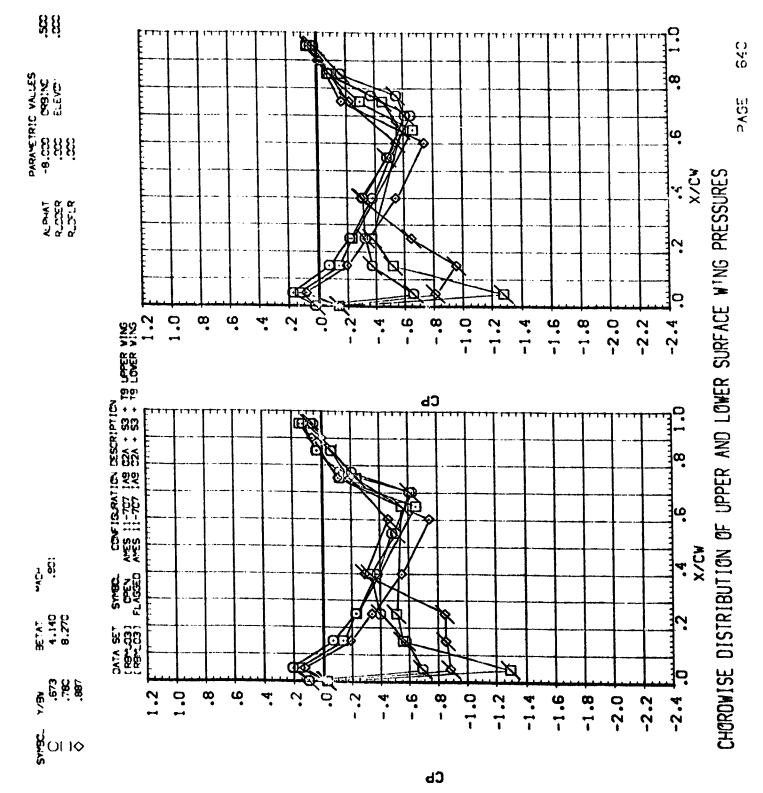
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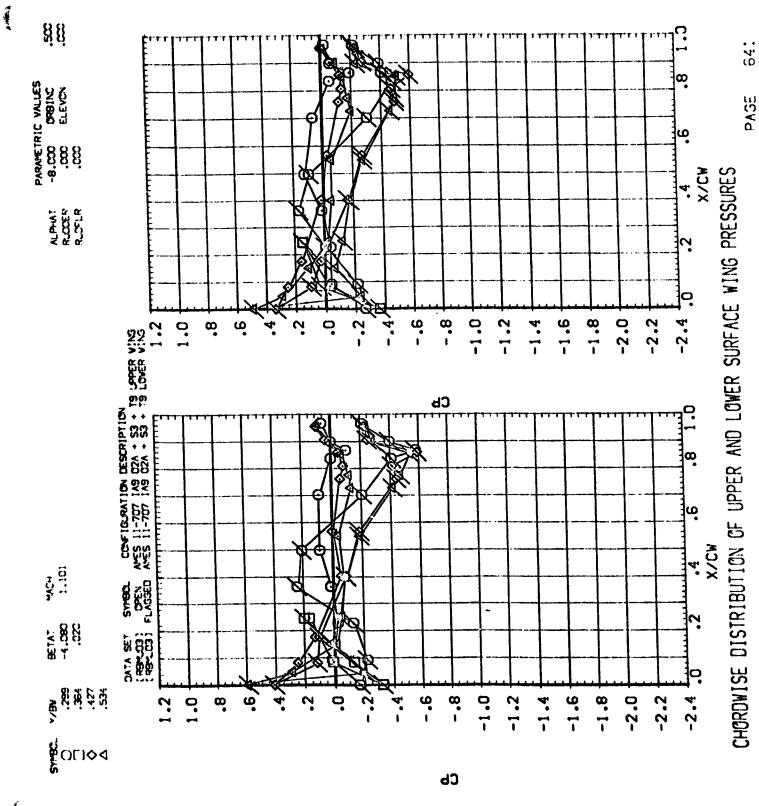




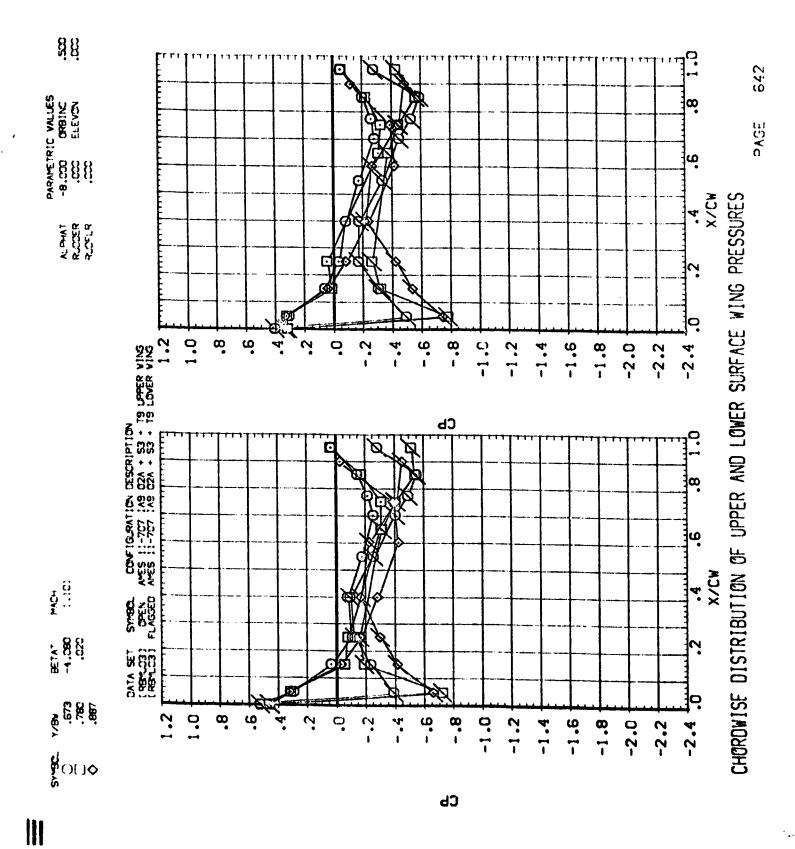
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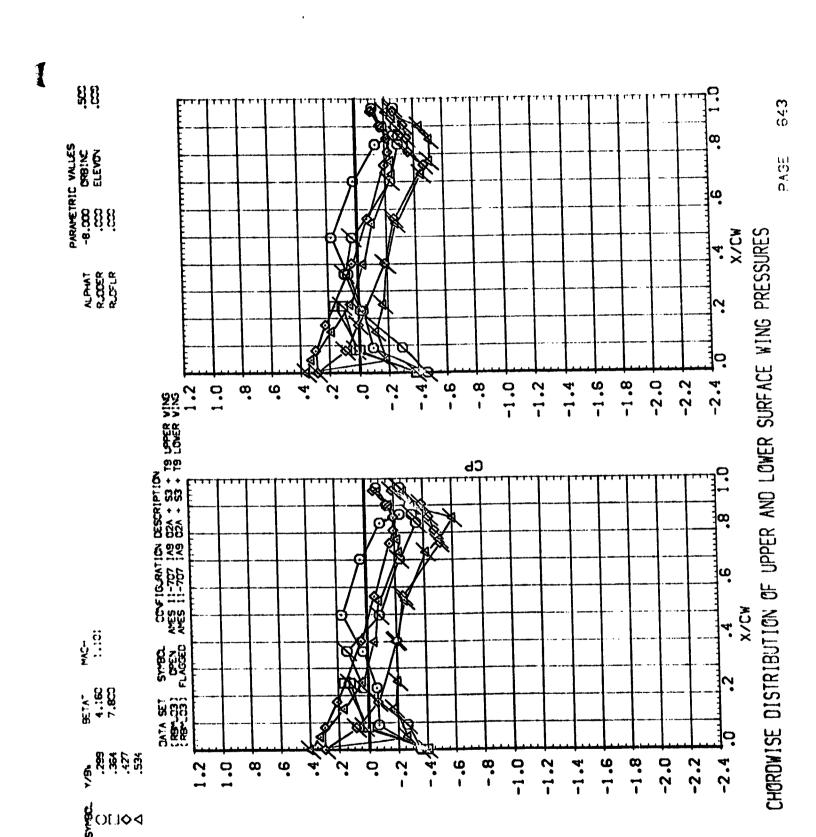






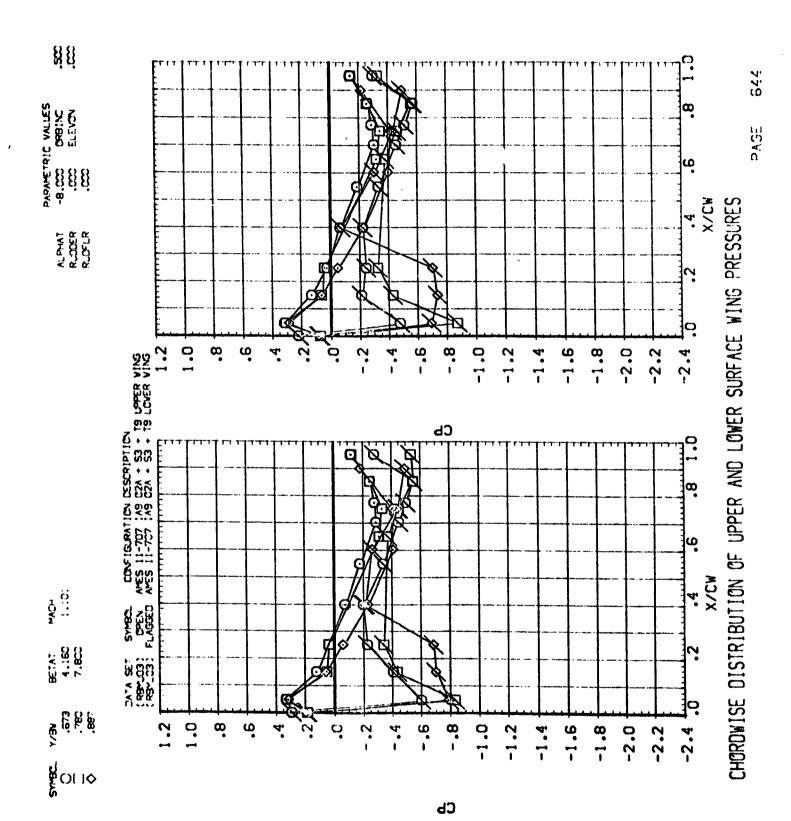
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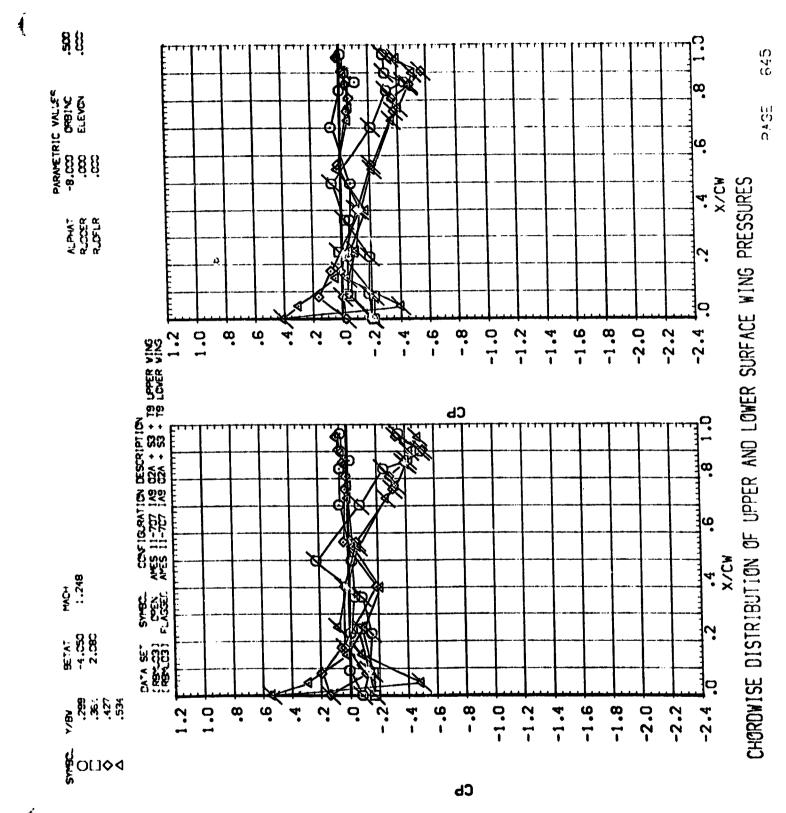




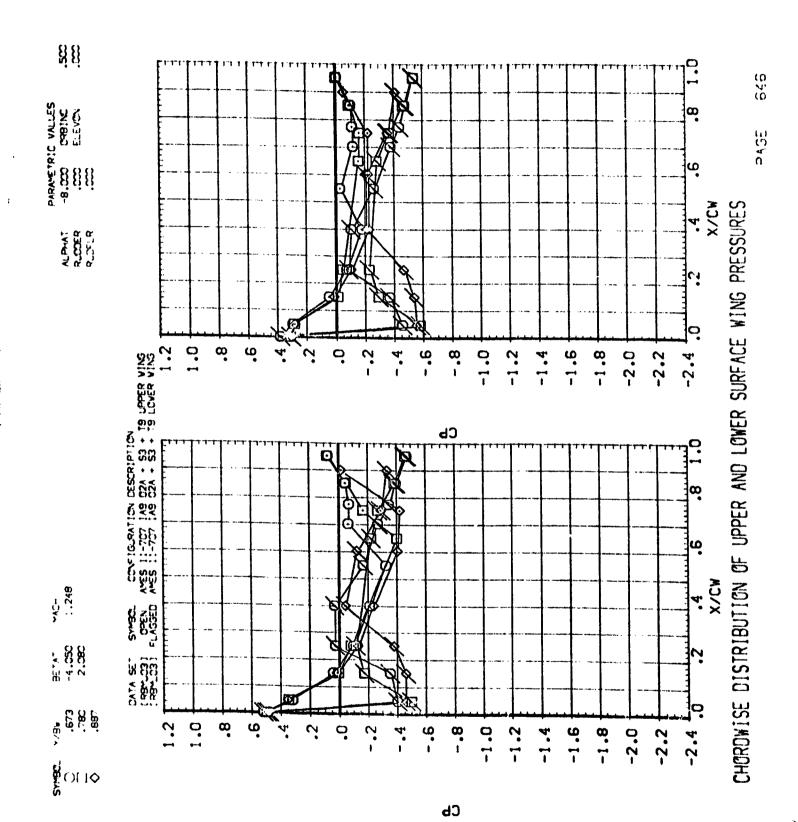
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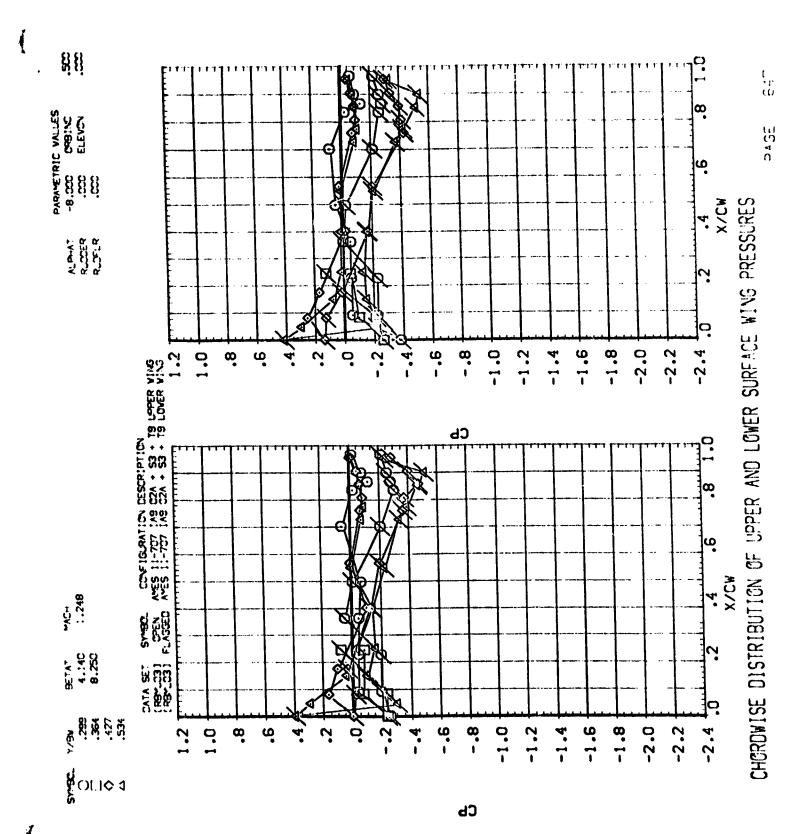
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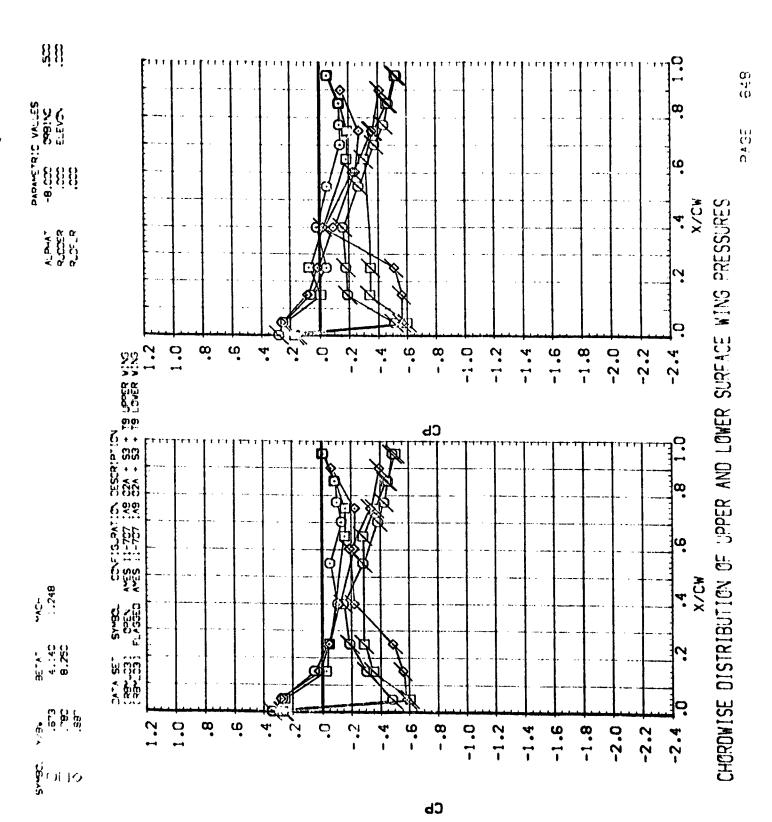


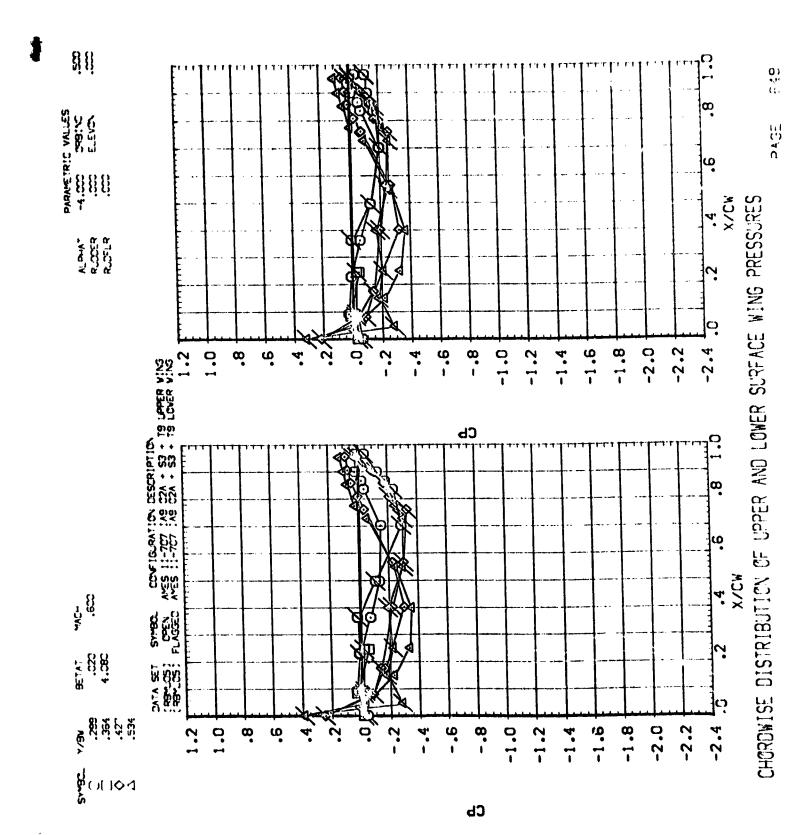
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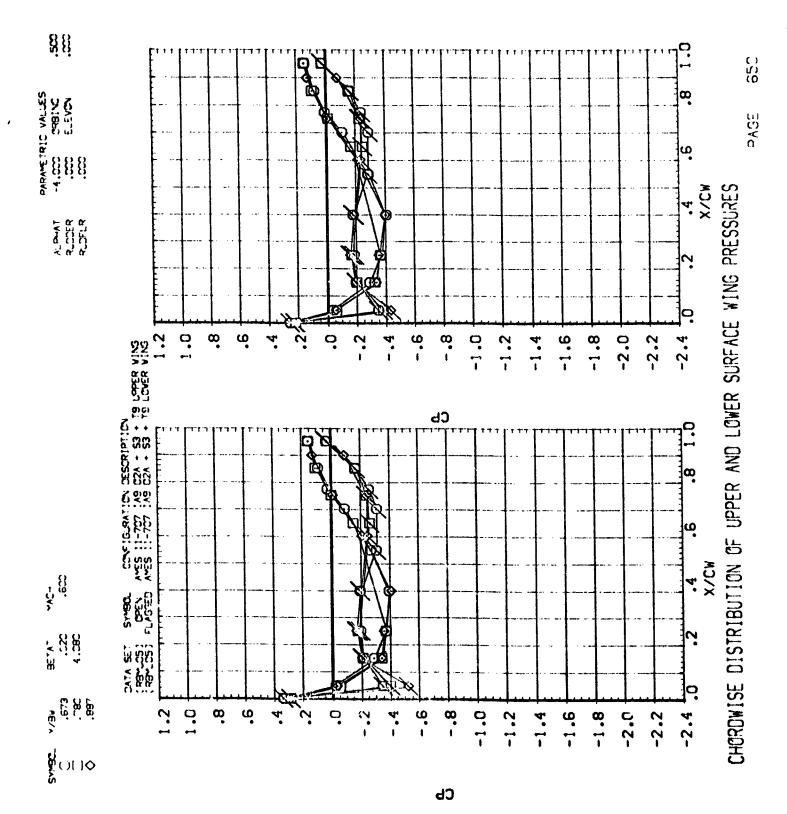




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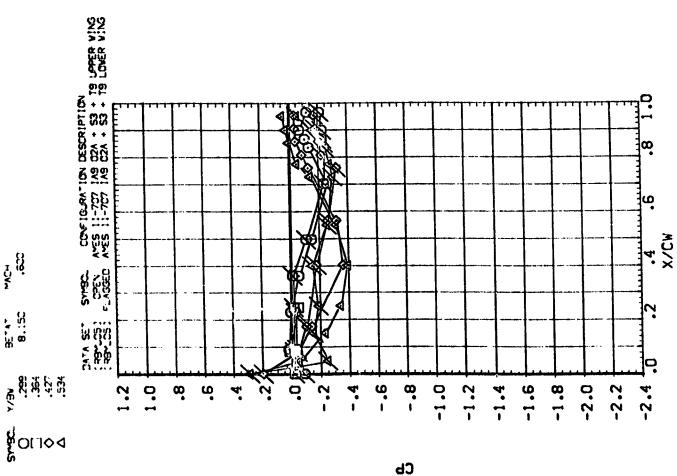






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CHORDWISE DISTRIBUTION OF UPPER AND LOWER SURFACE WING PRESSURES



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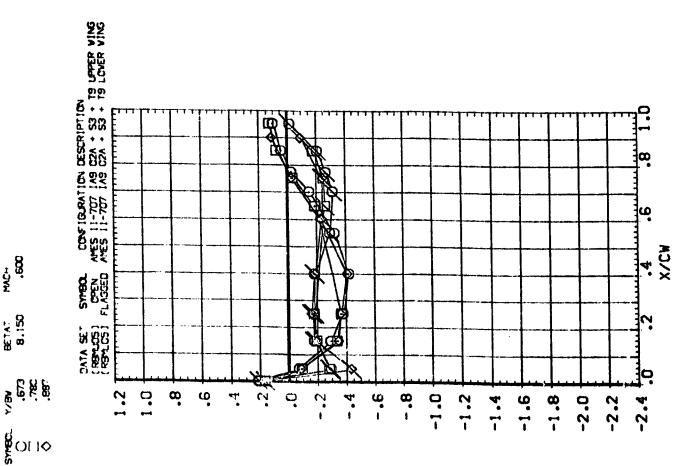
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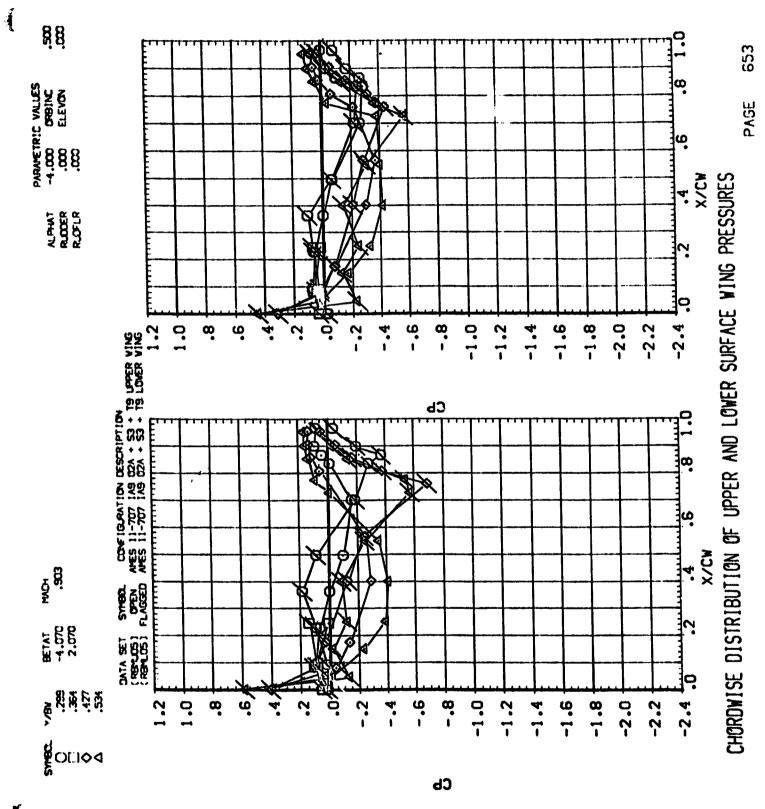
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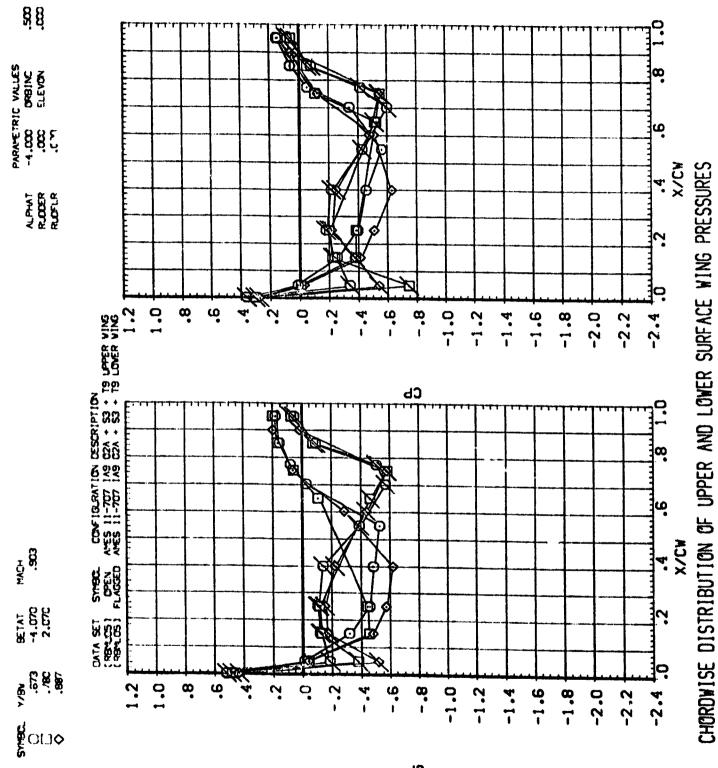
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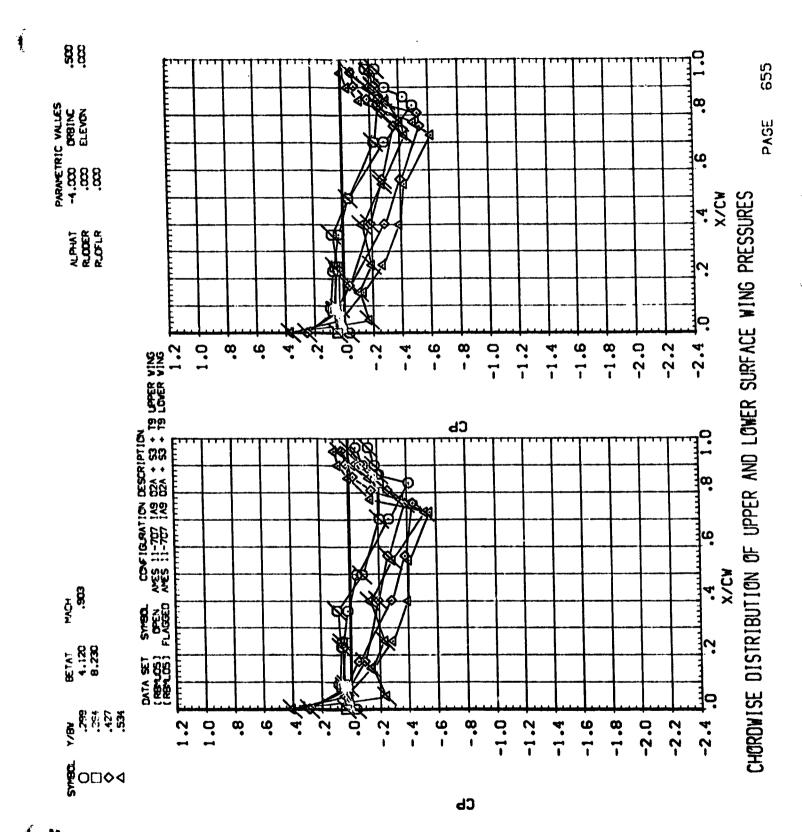


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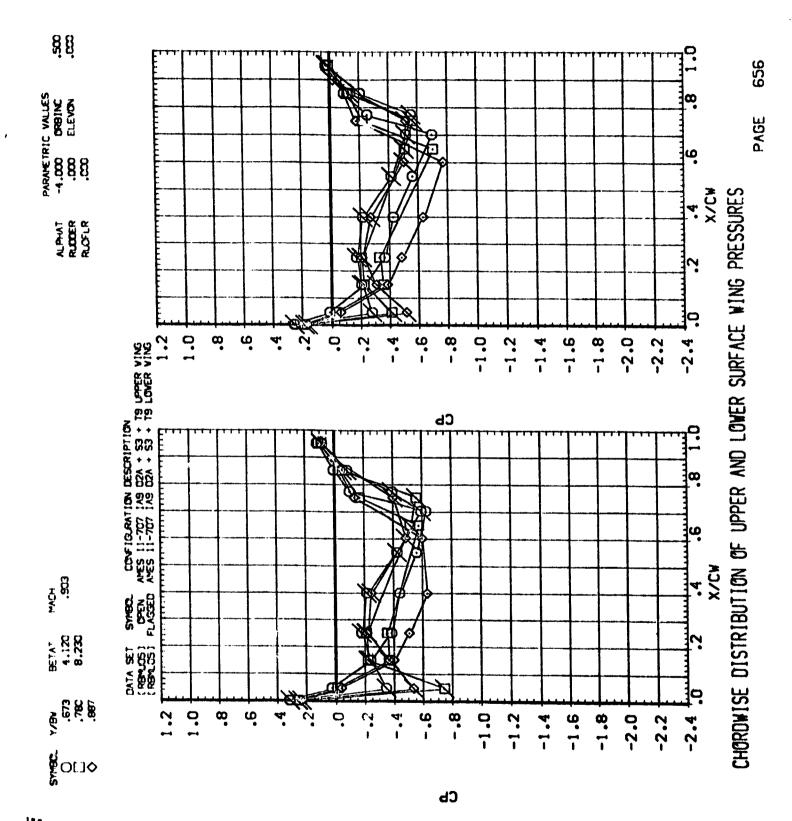


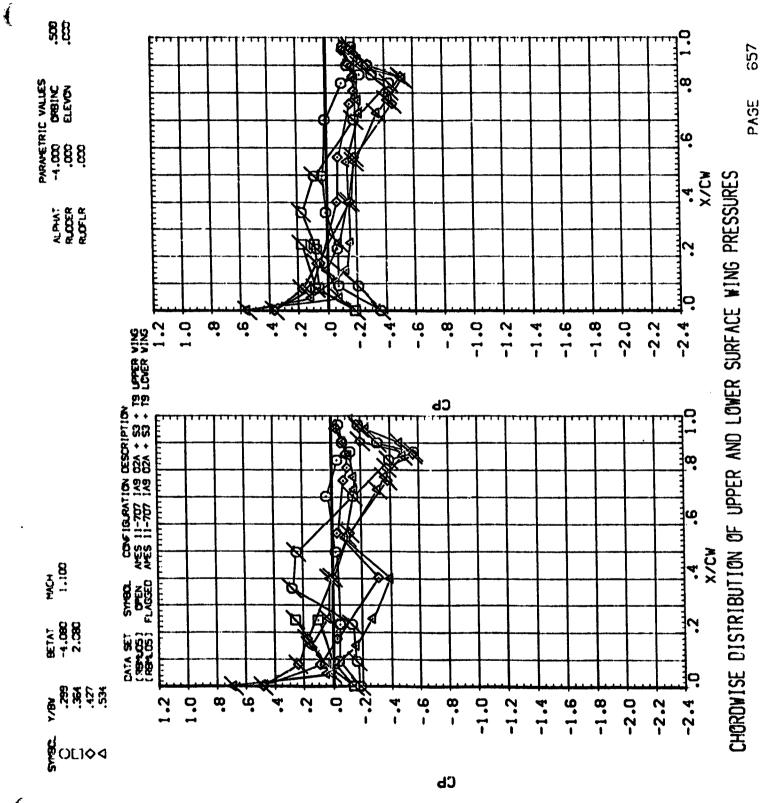


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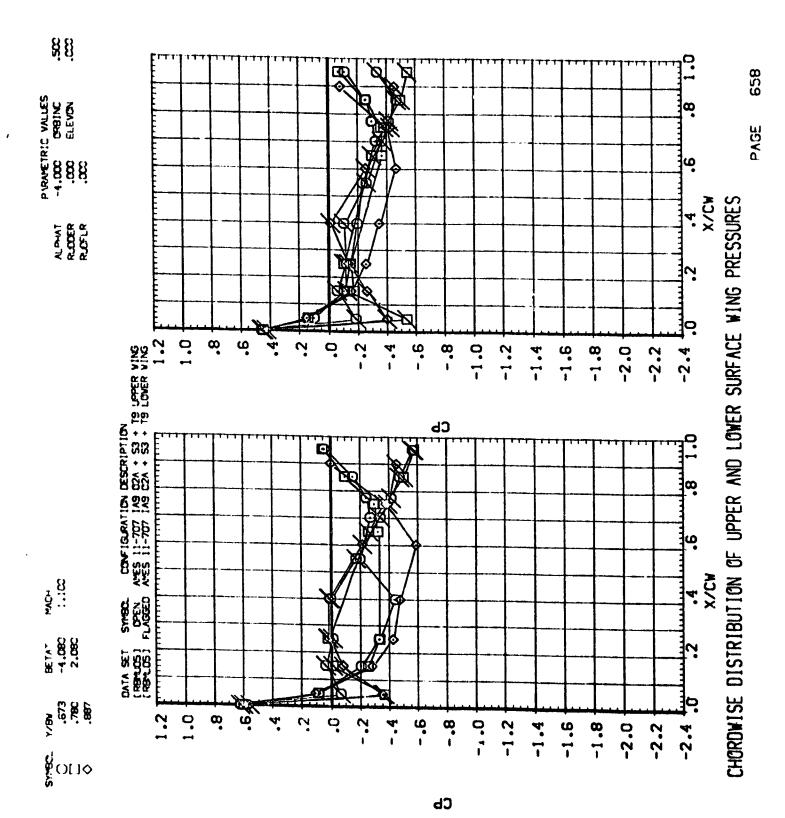


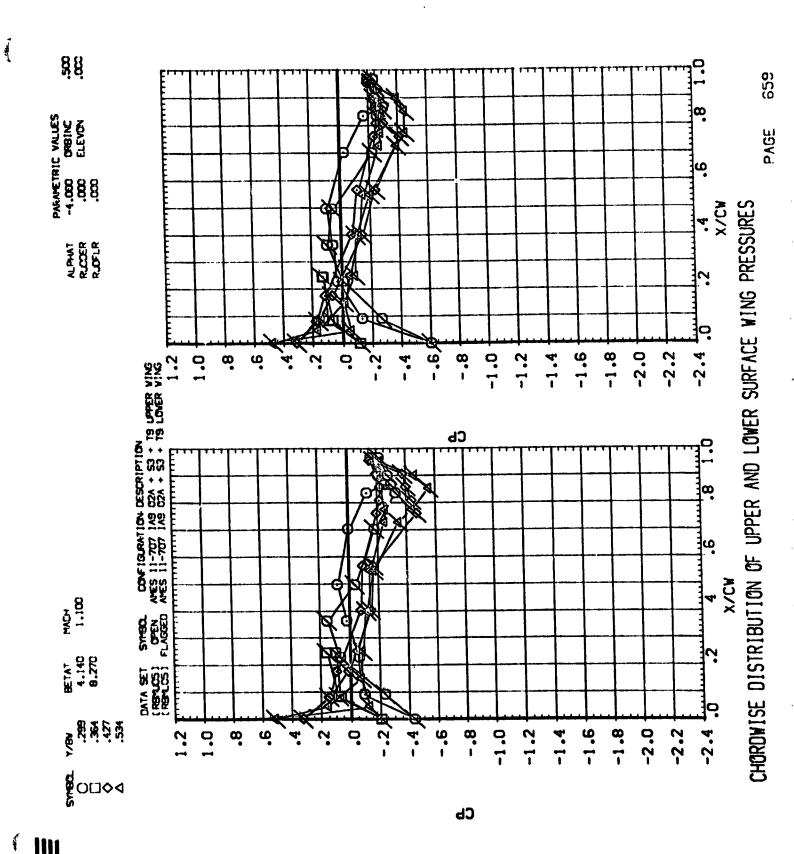
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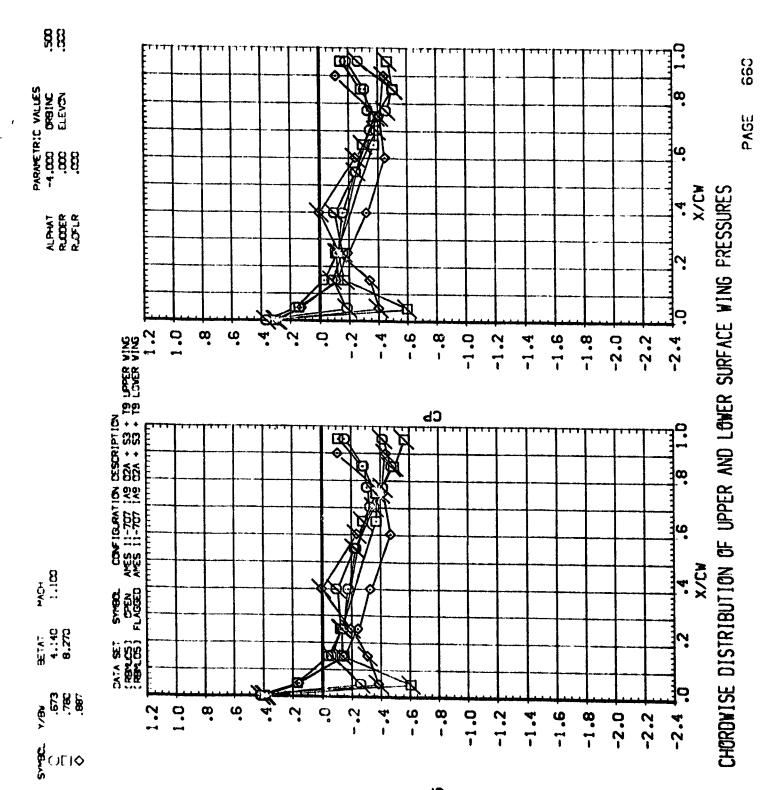




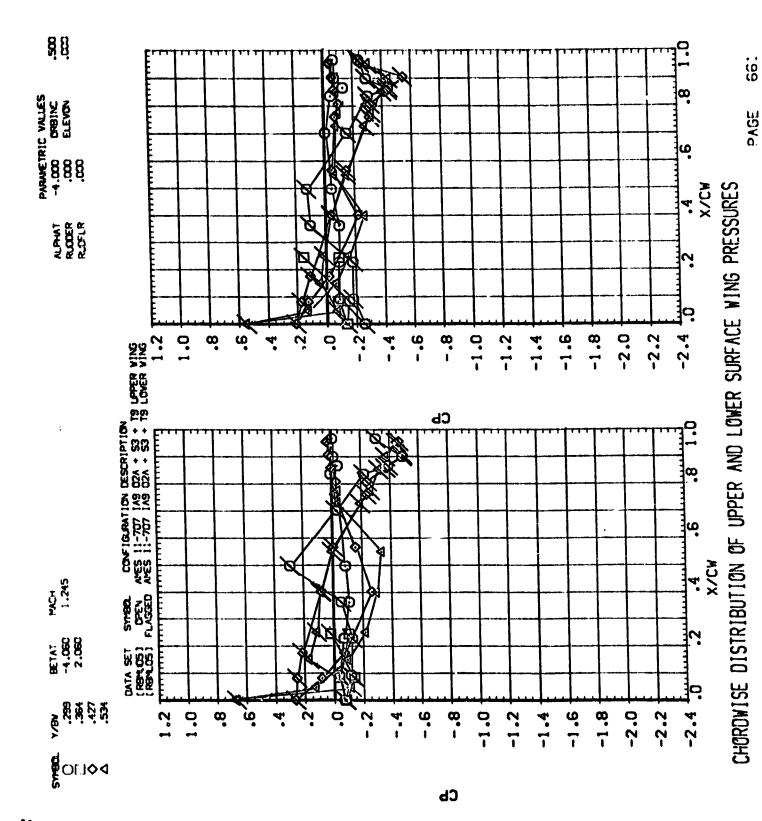
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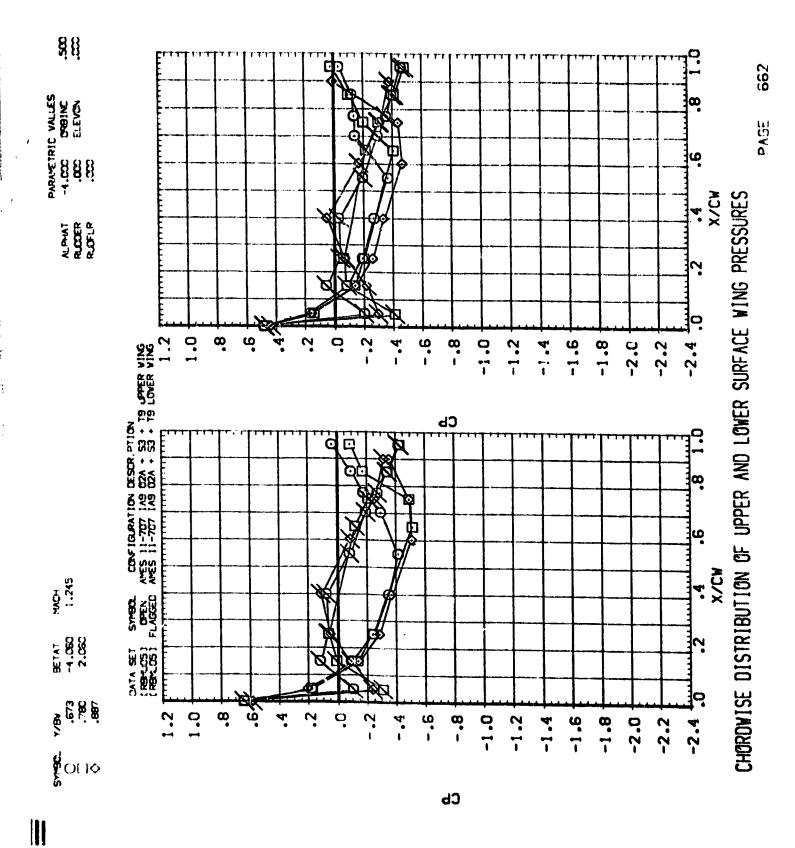


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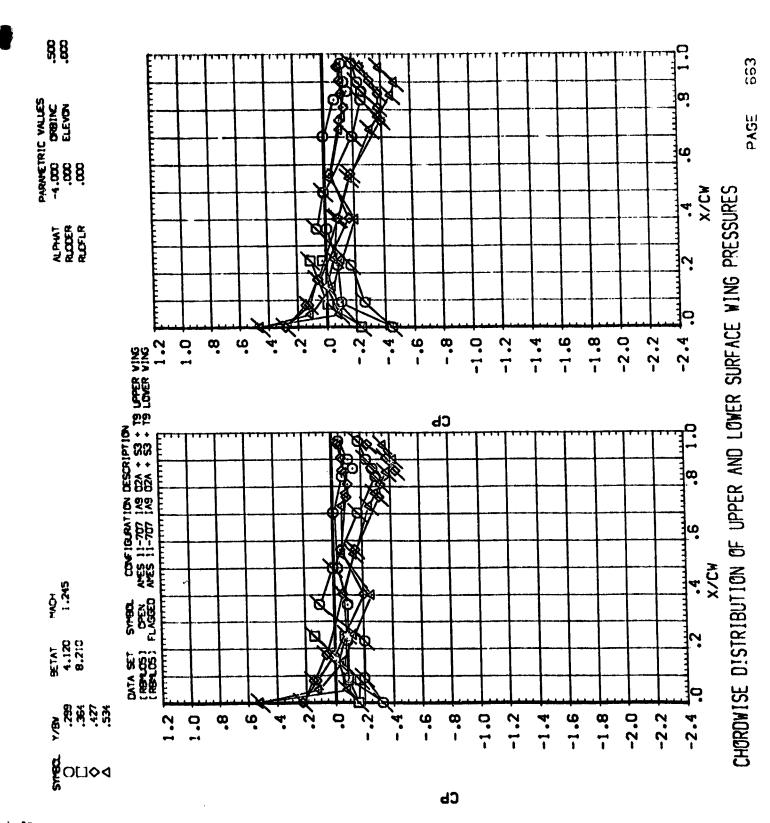
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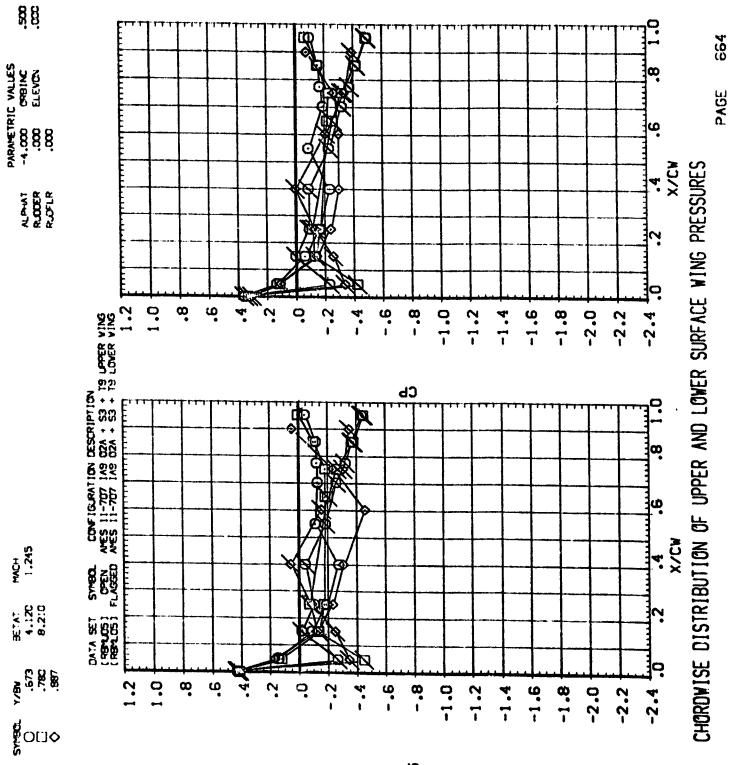
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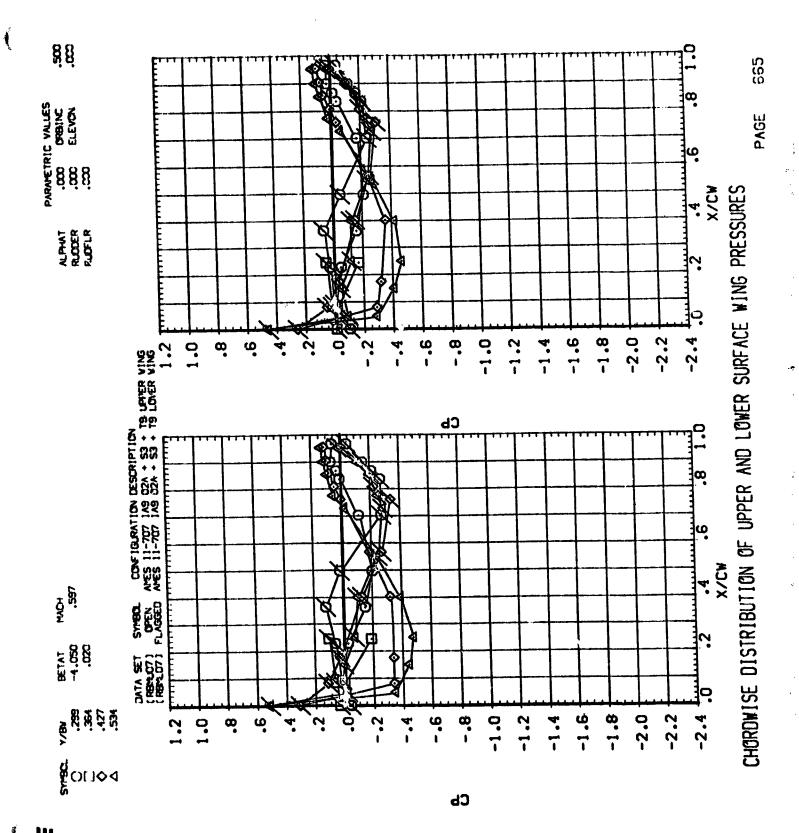
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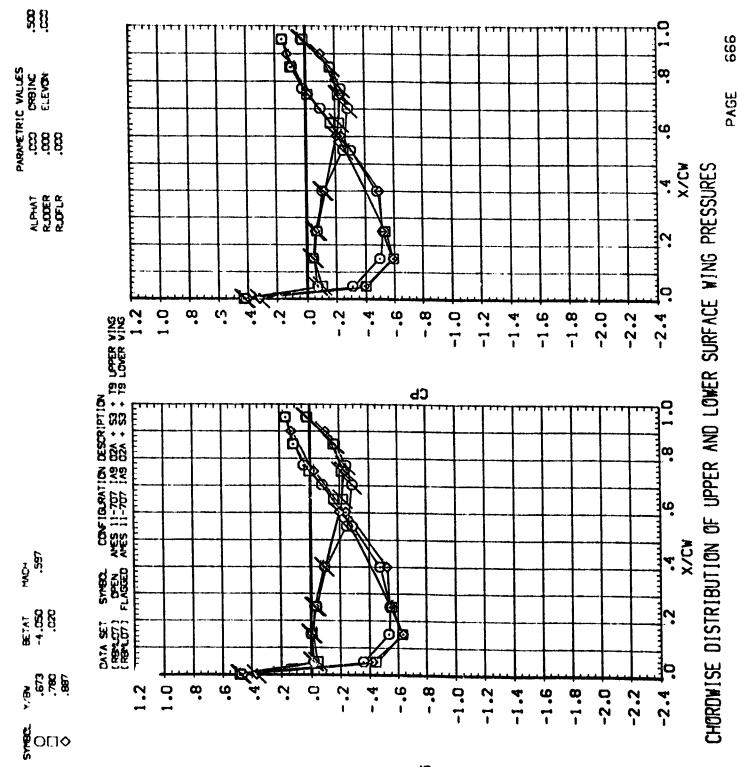




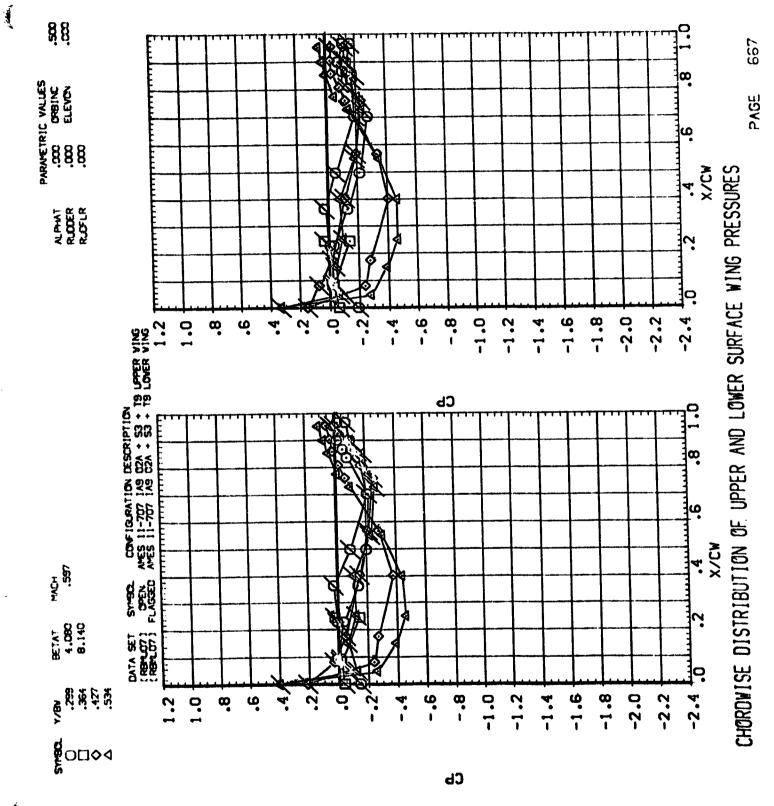
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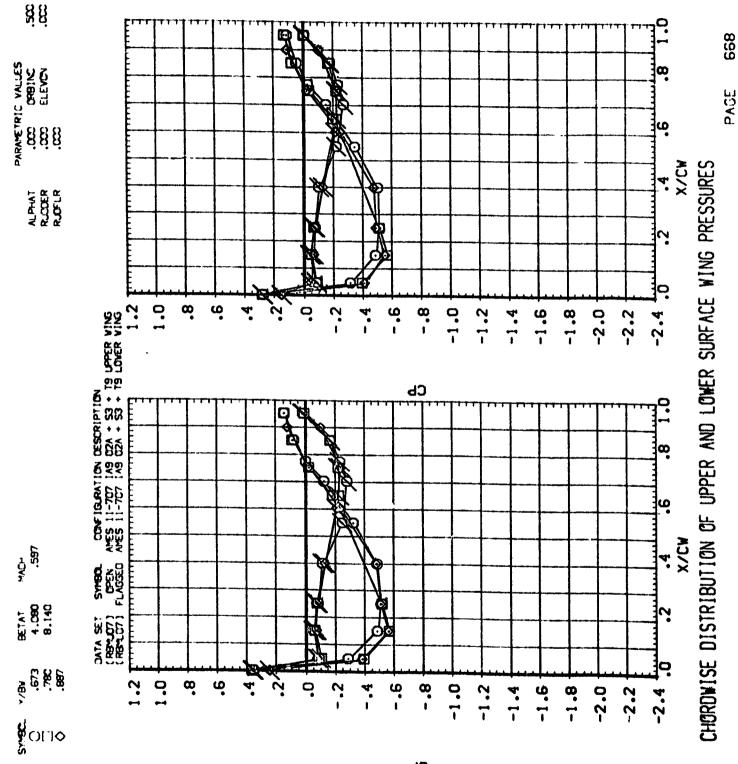
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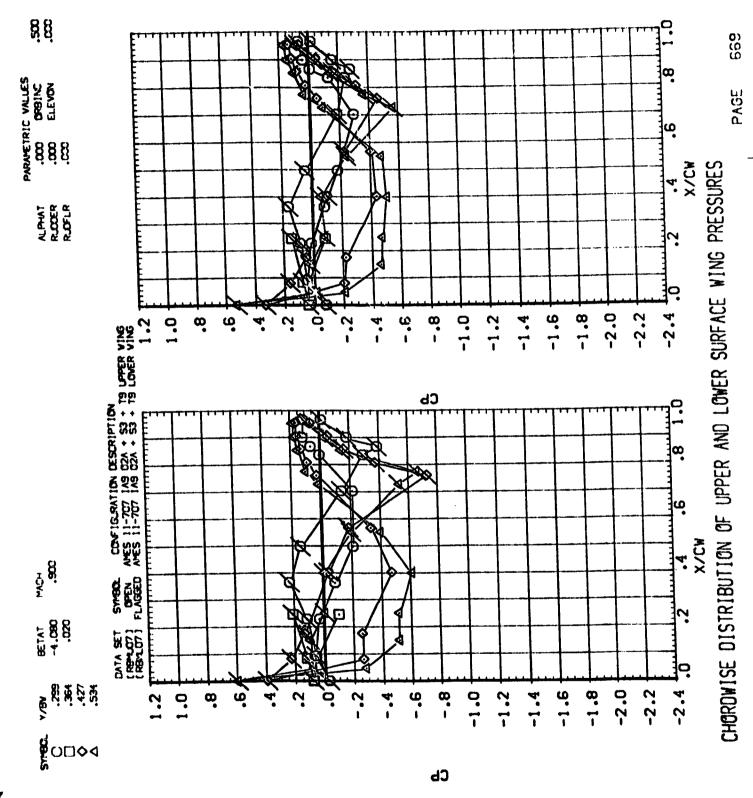




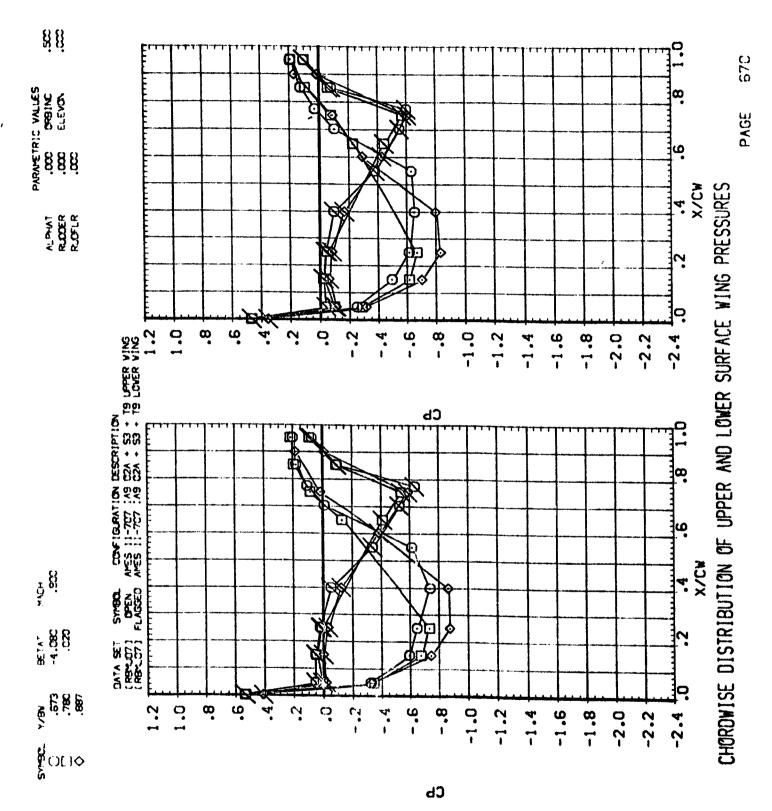
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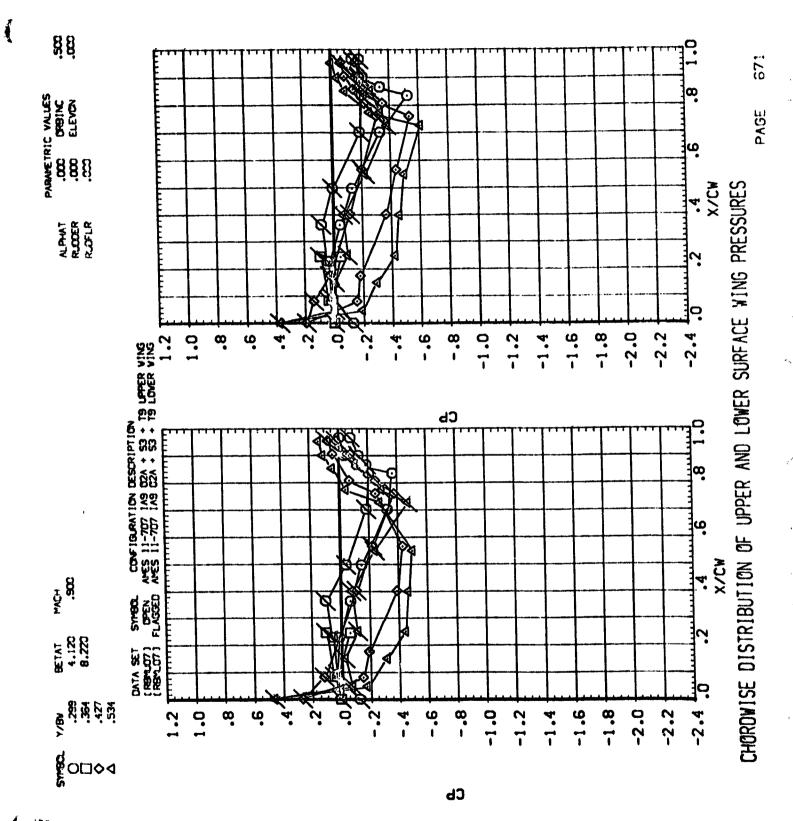




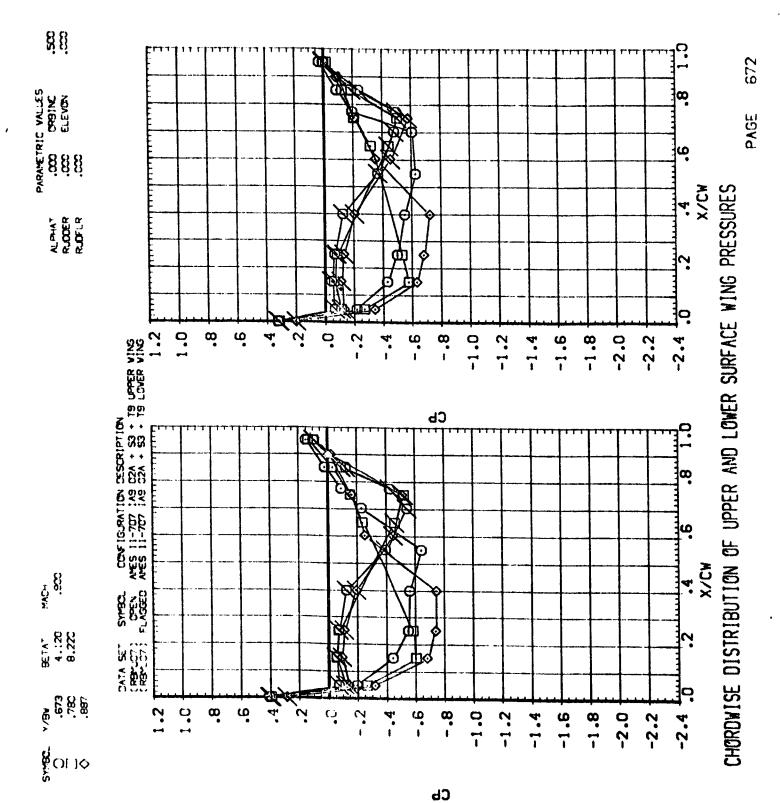


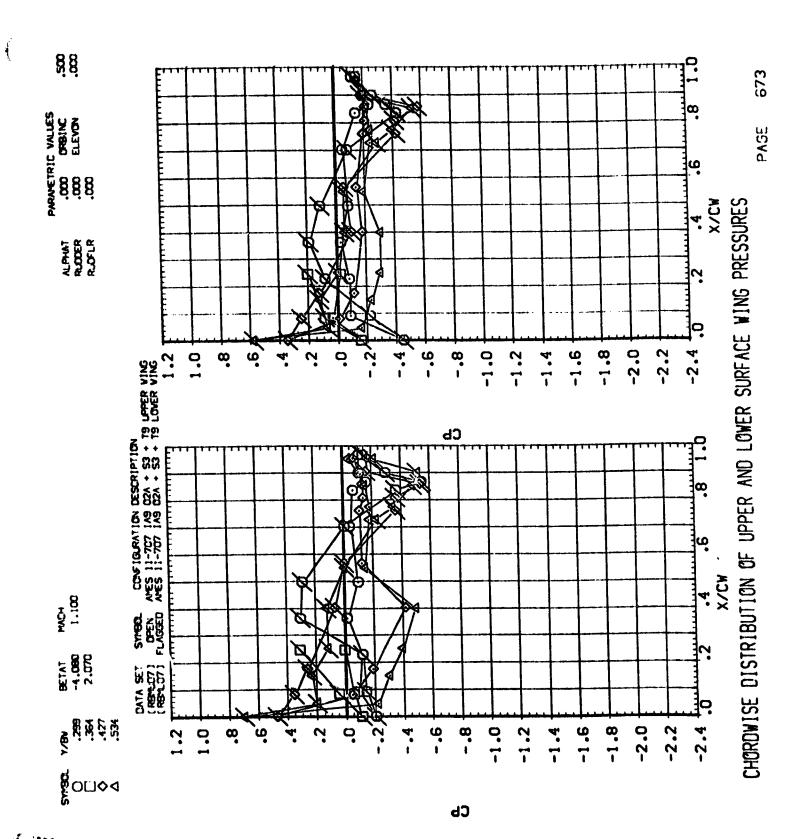
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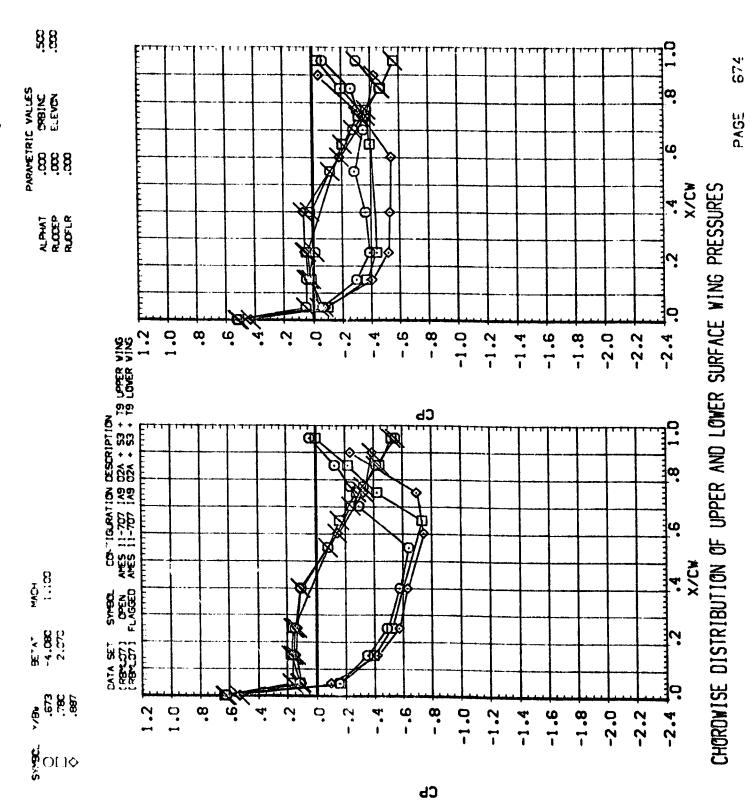


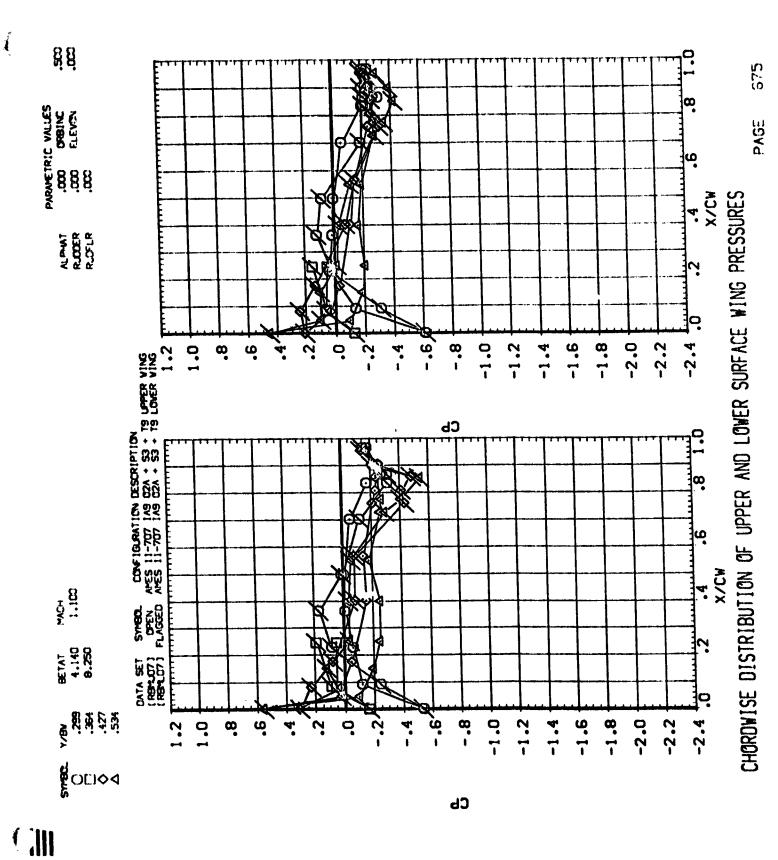


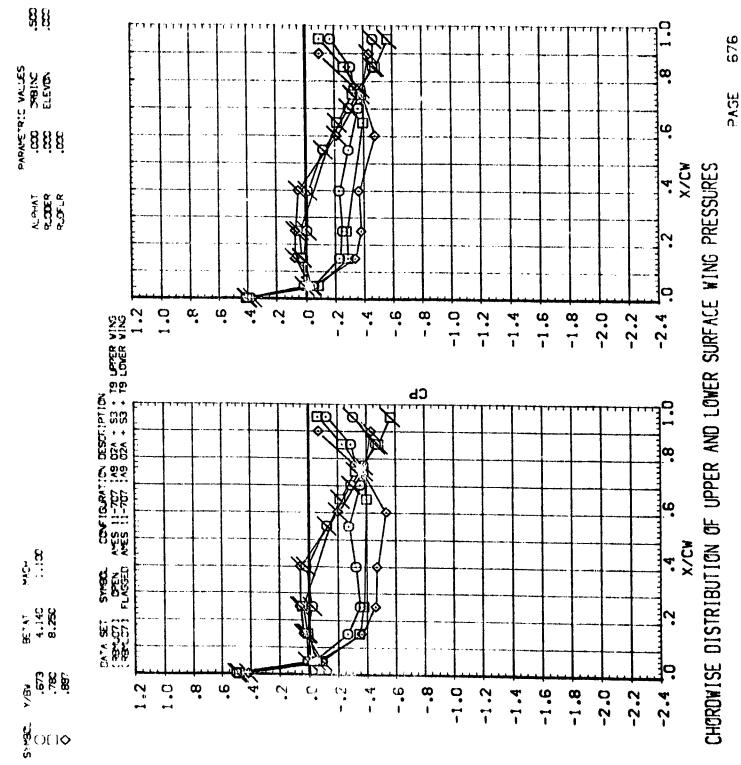
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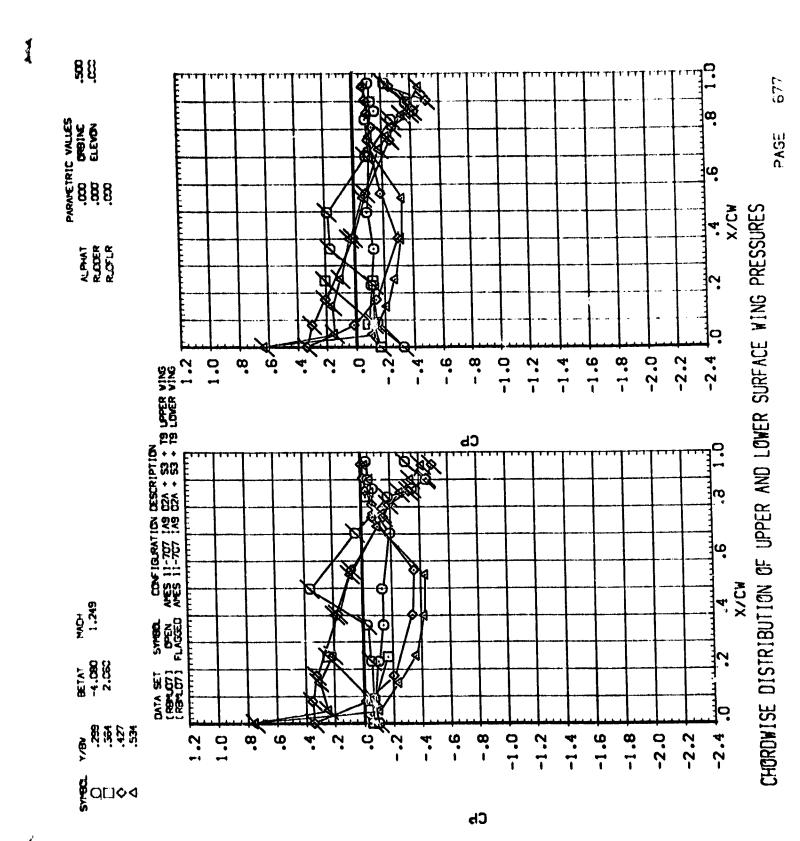




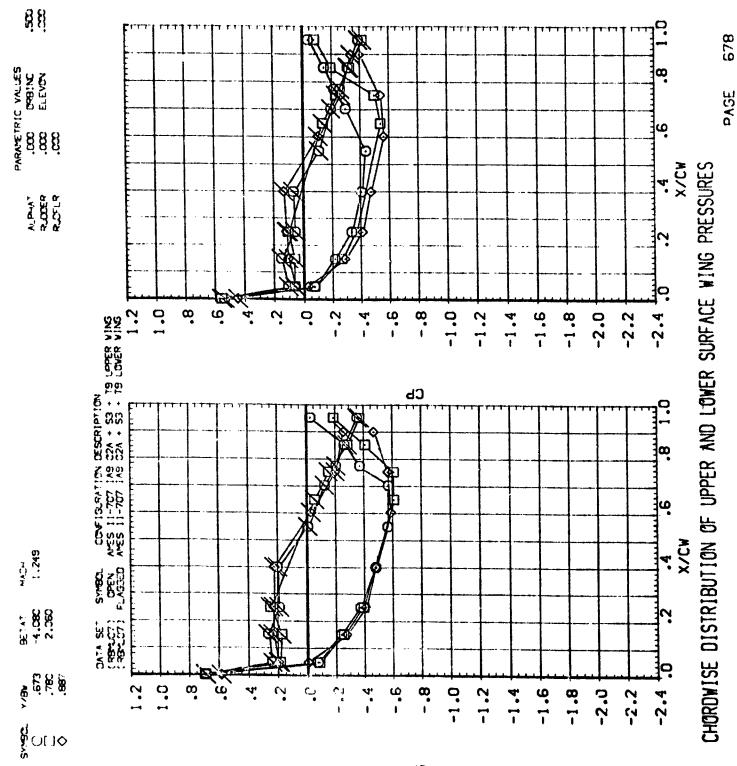






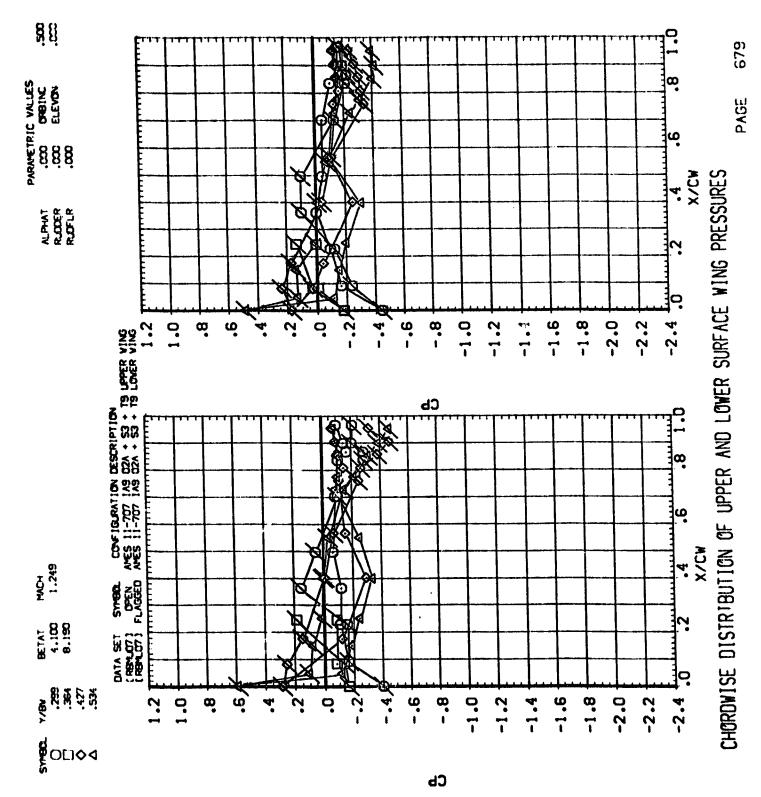


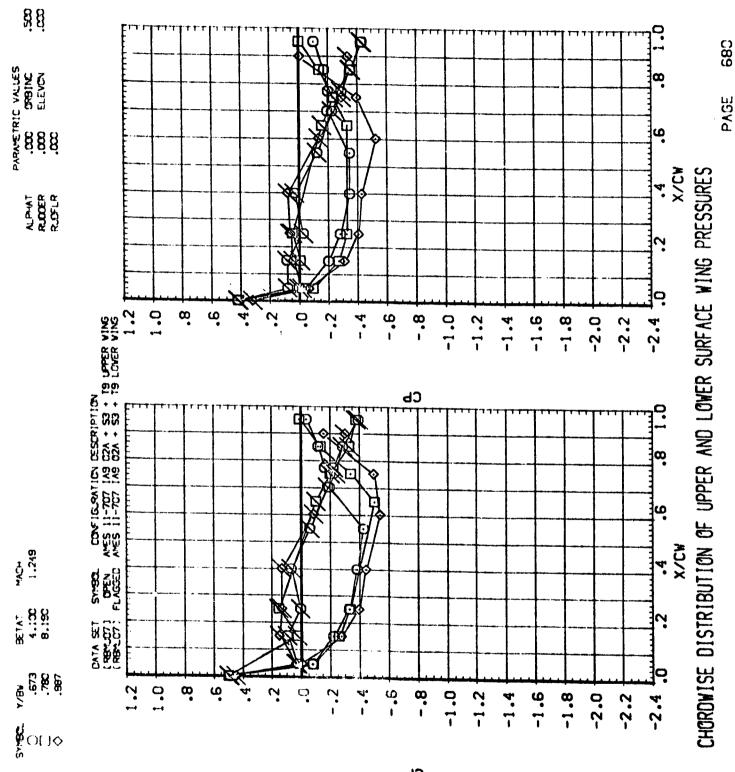
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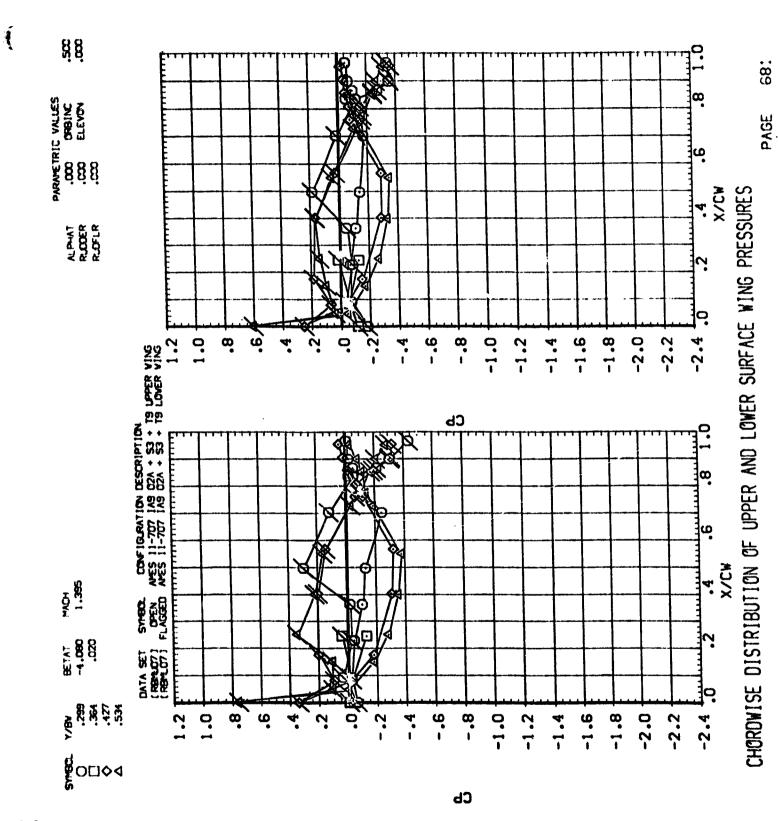


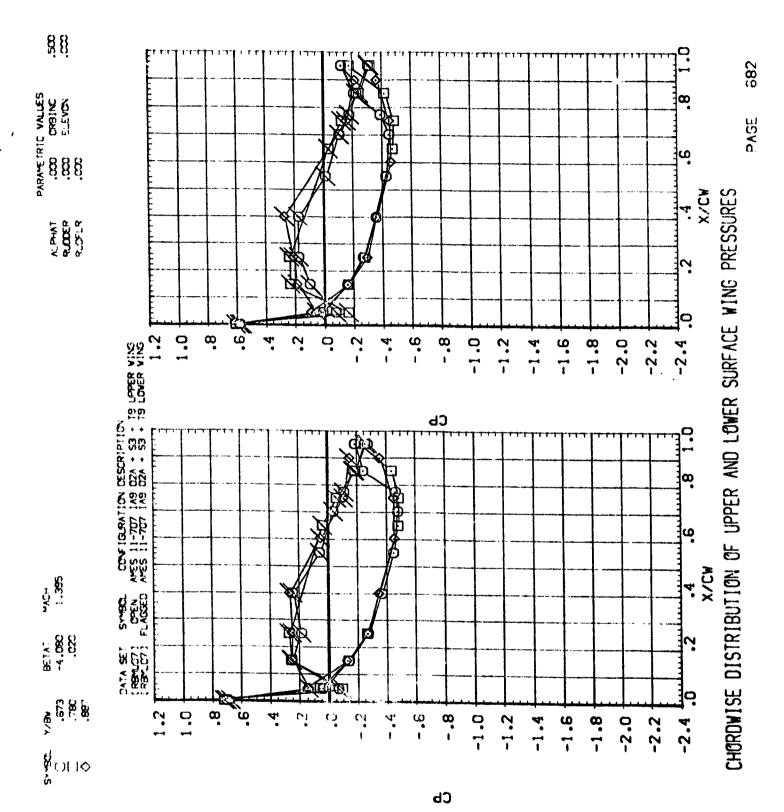
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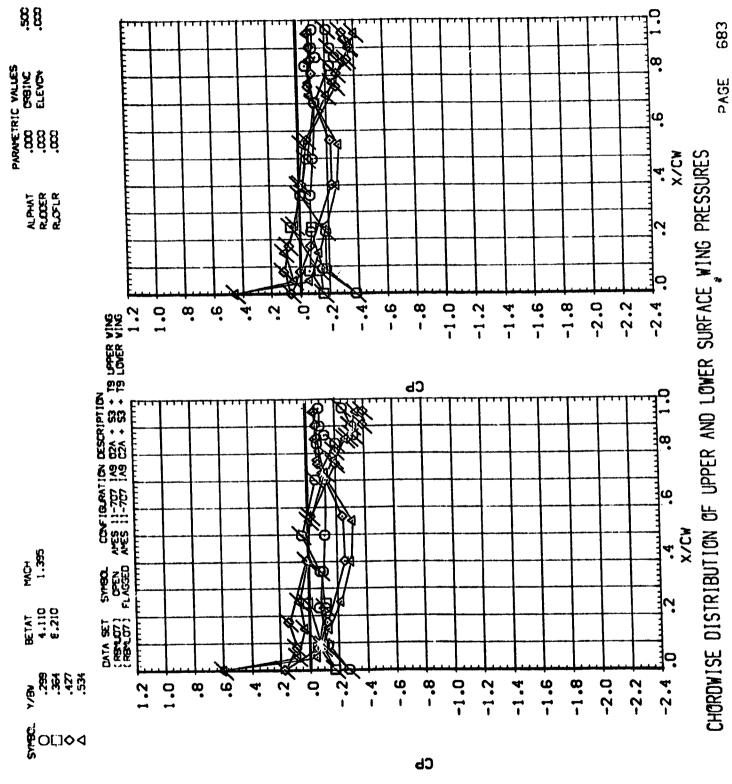
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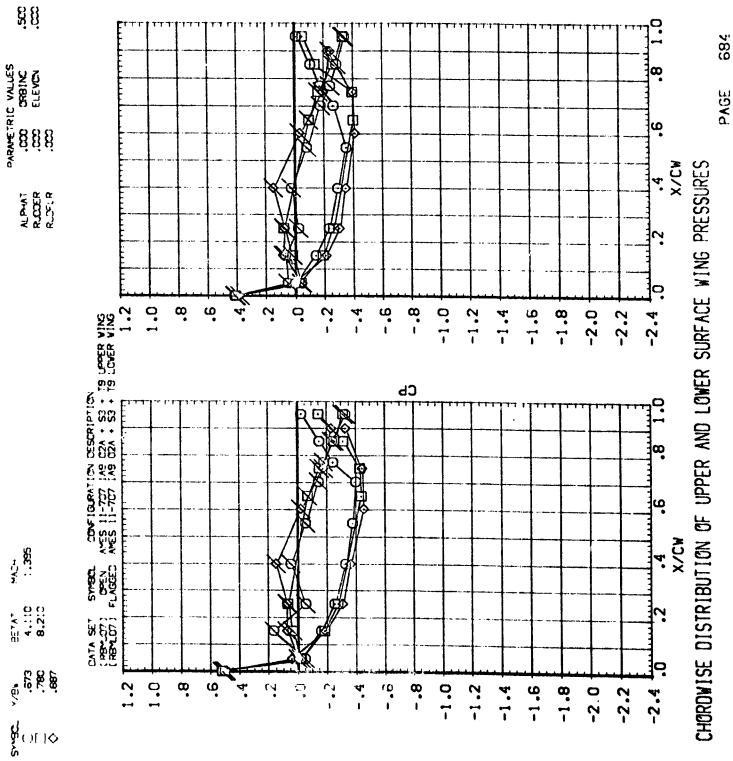


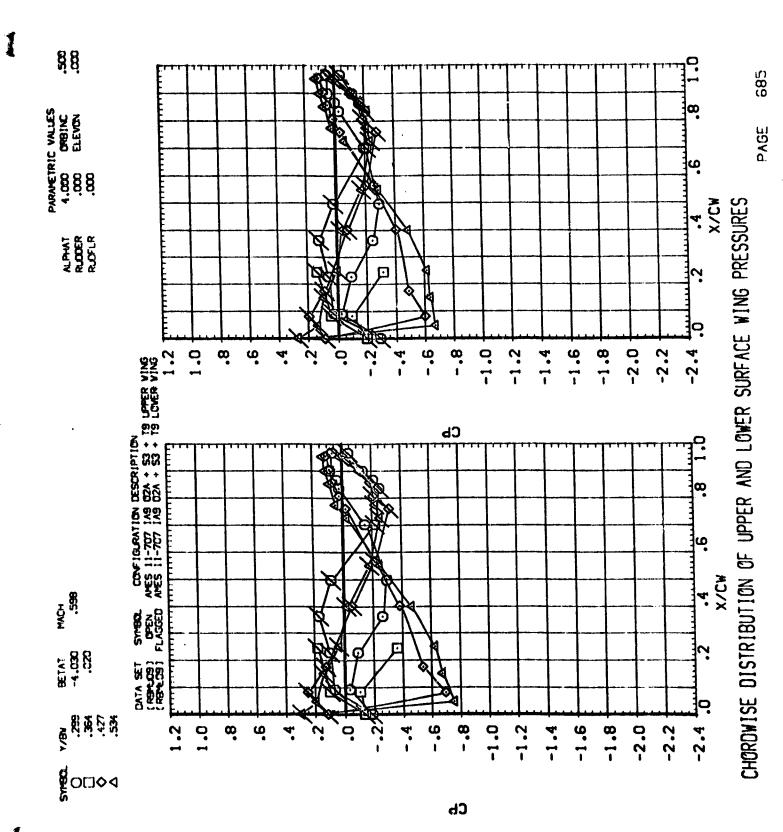




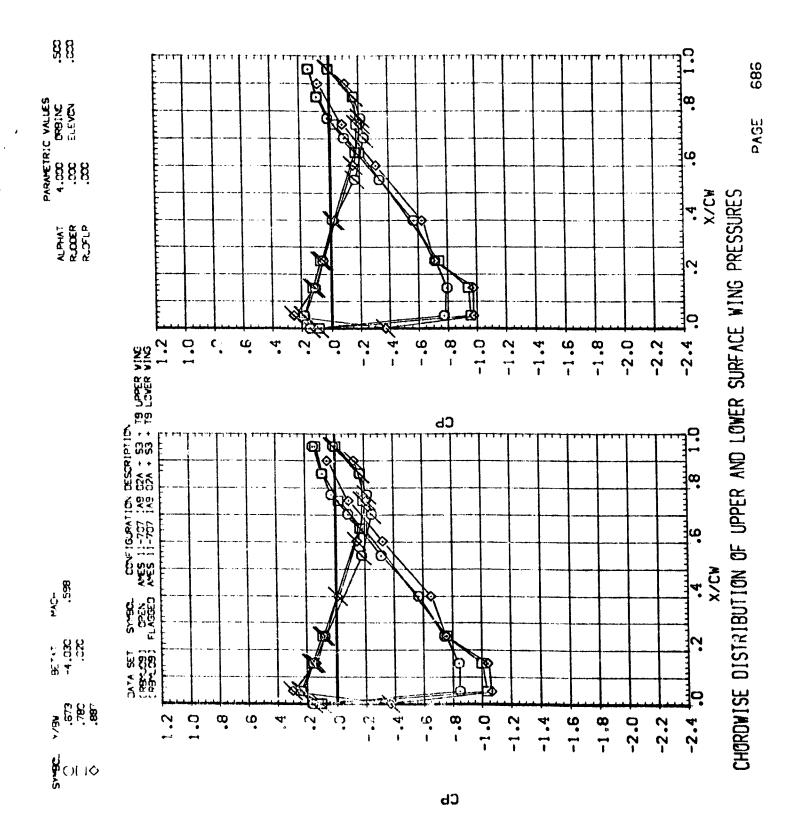


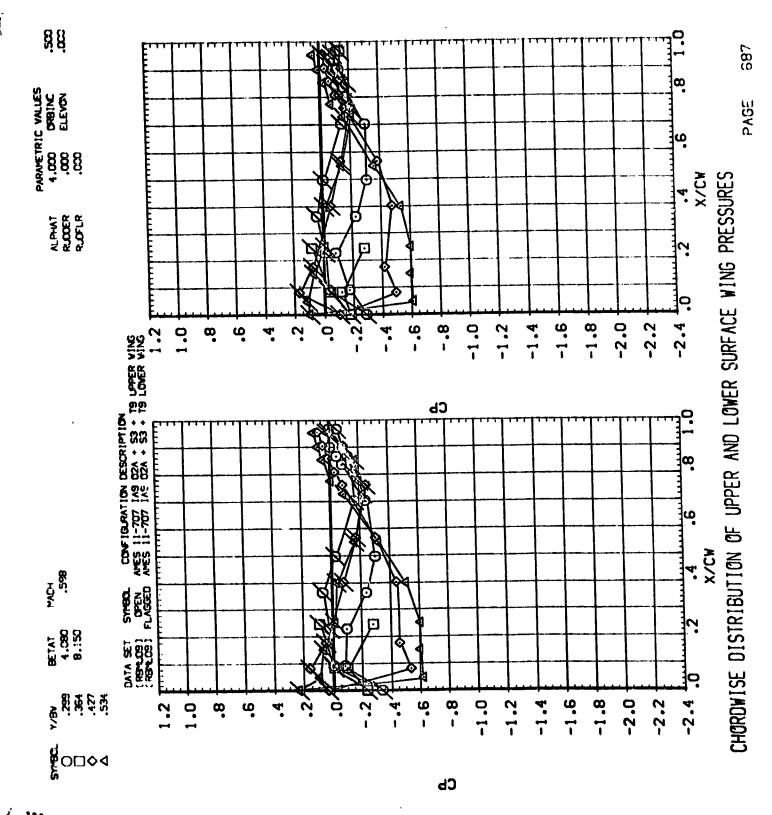
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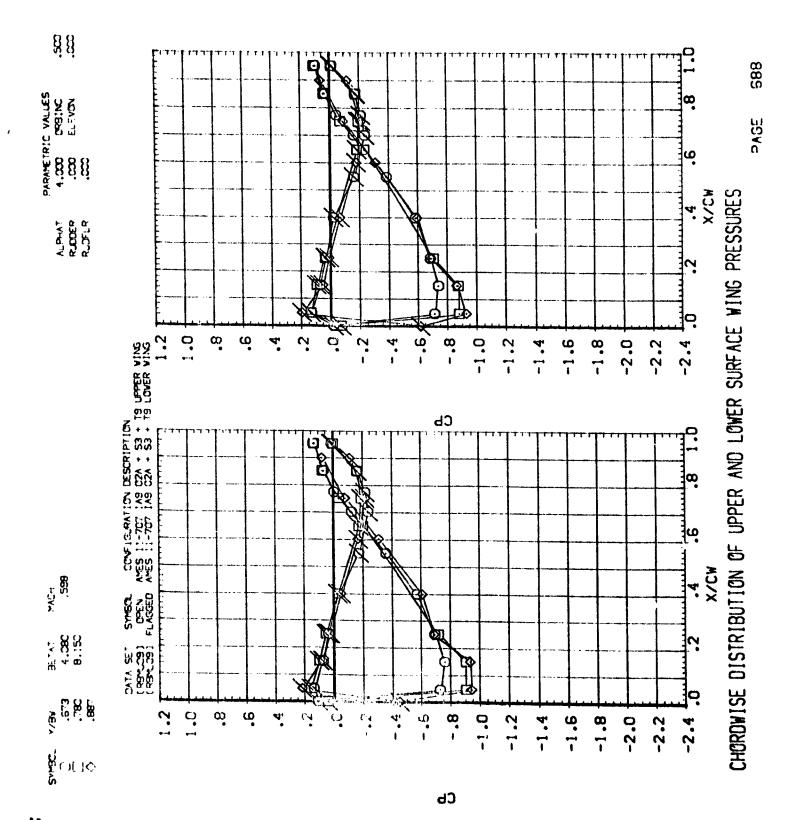


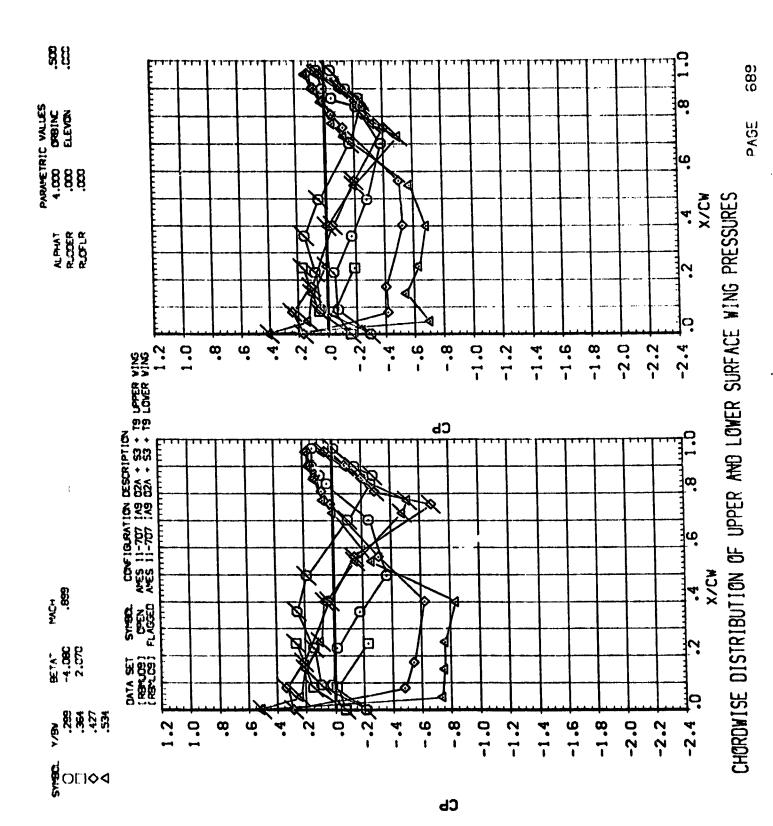
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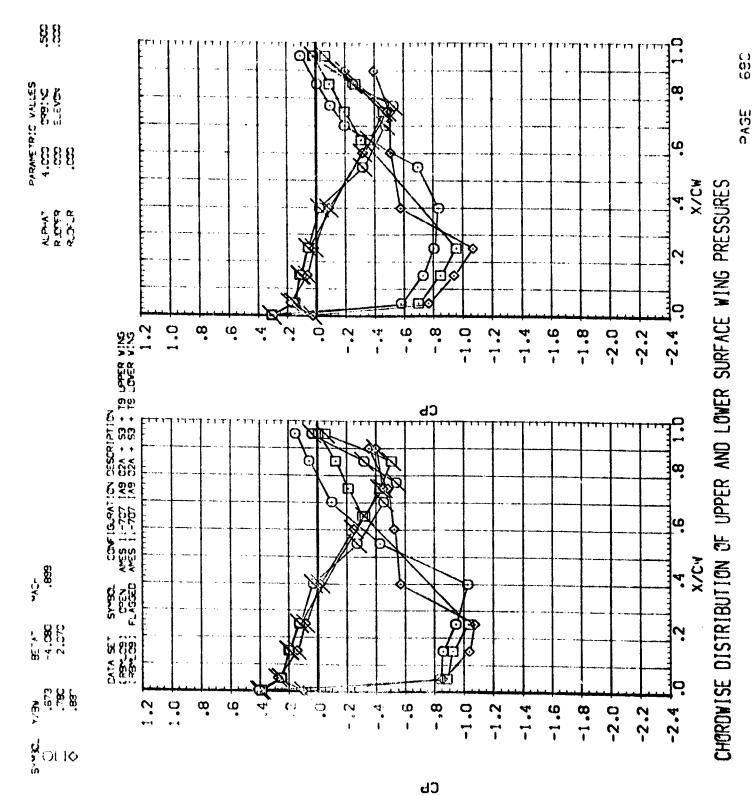


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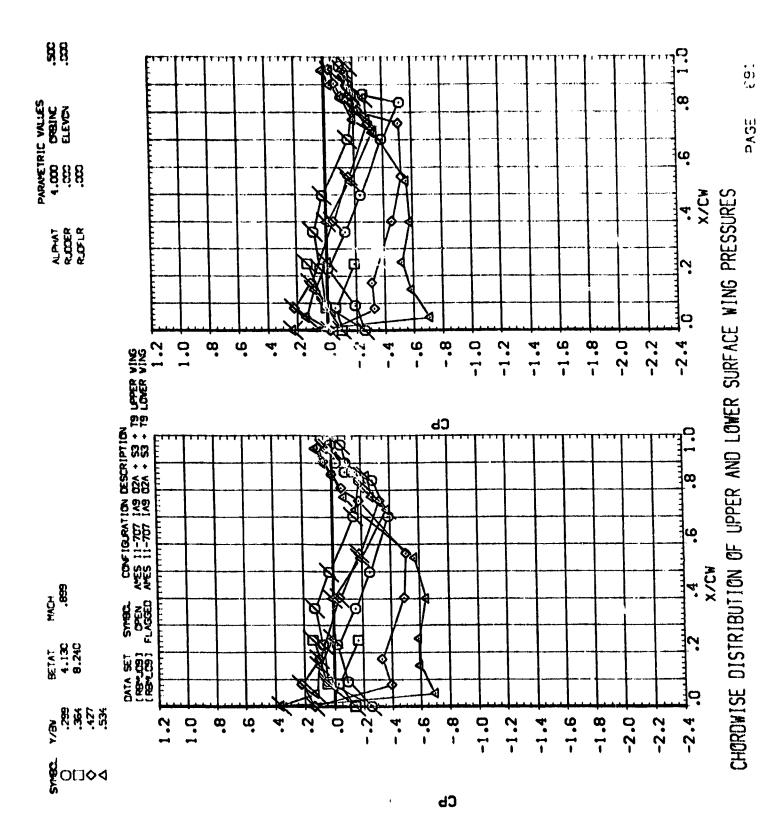


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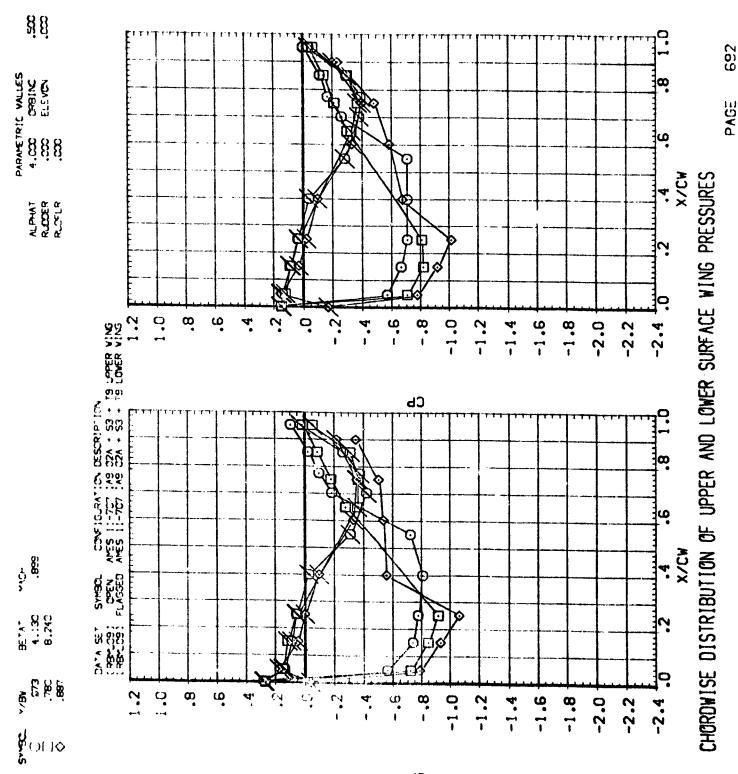
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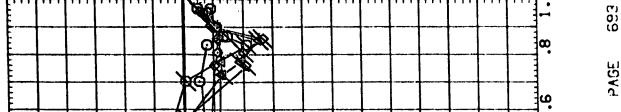
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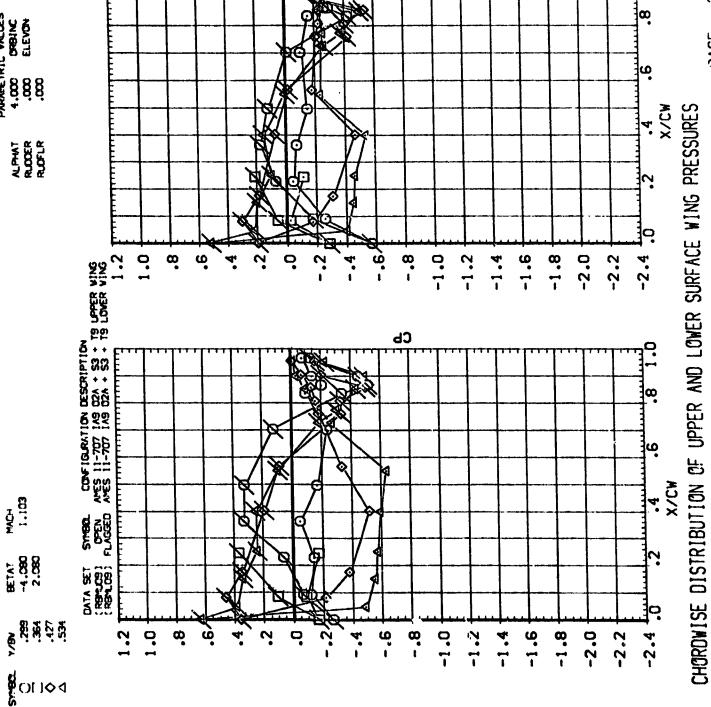
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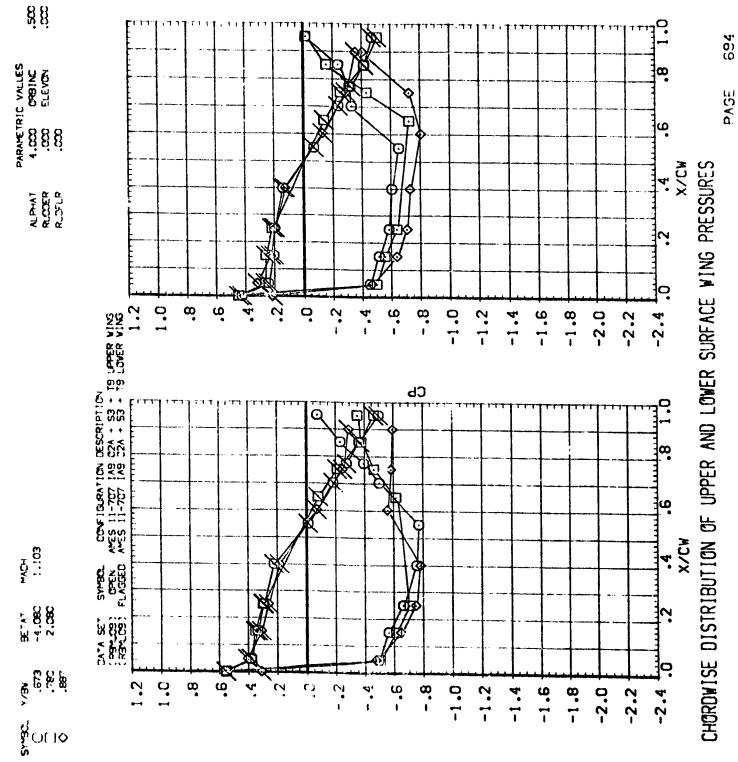
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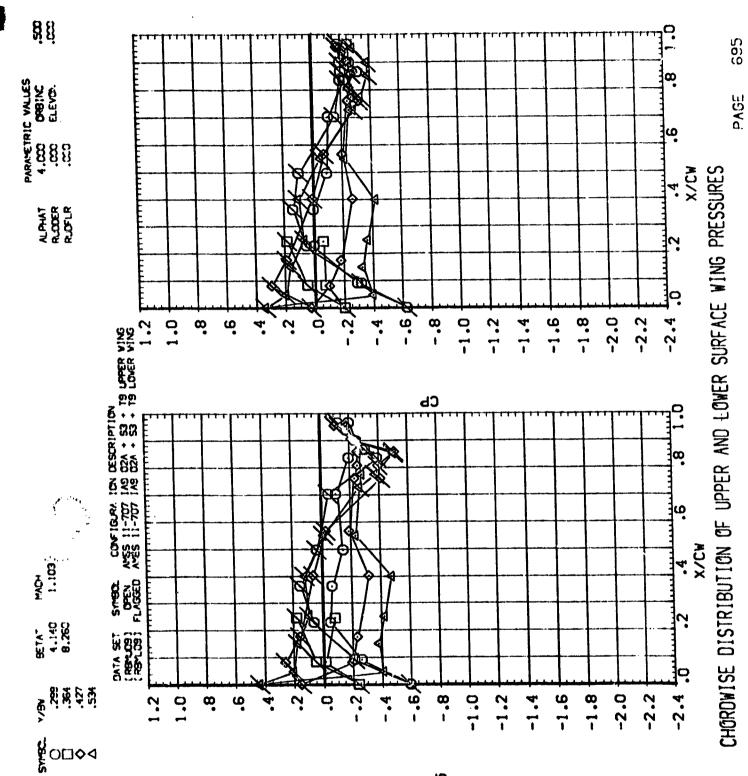
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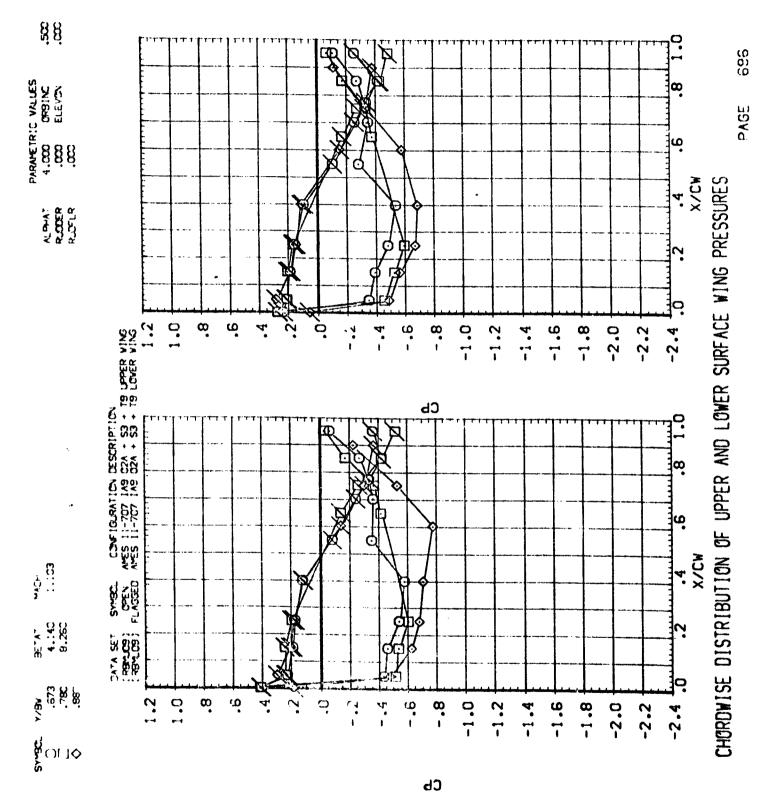
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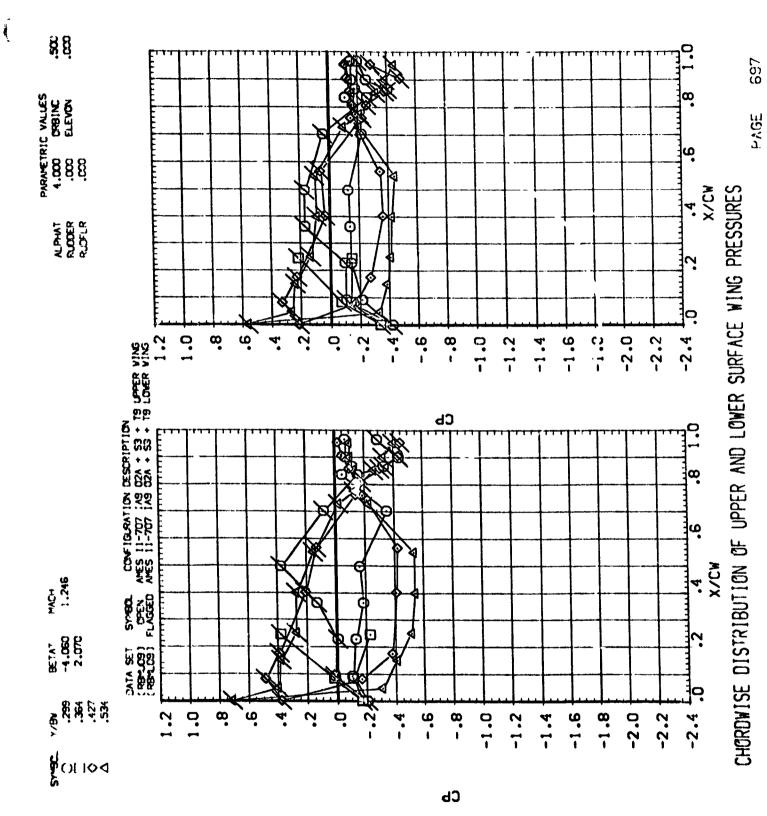
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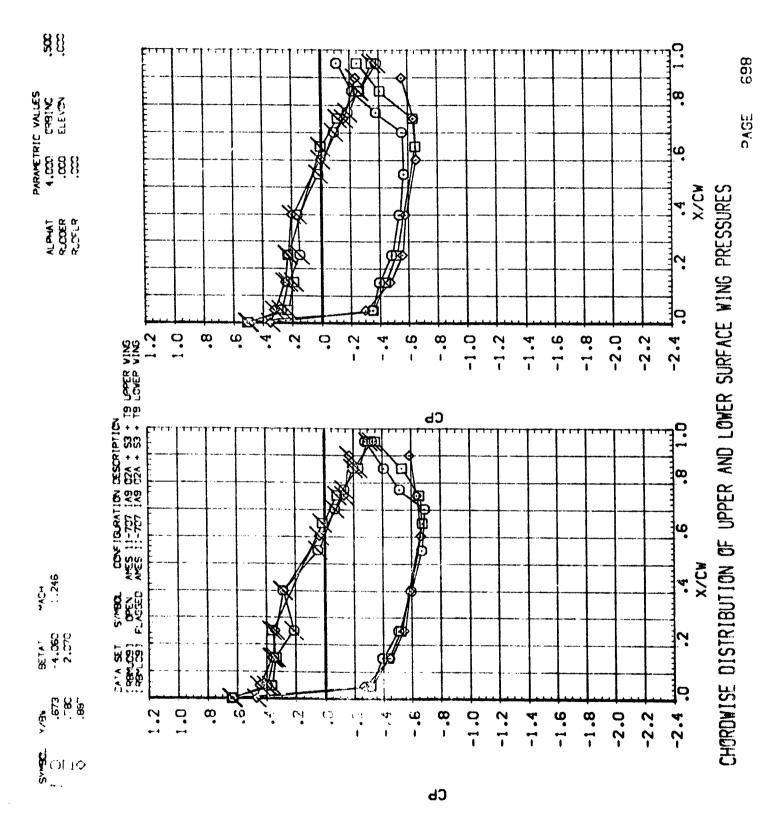
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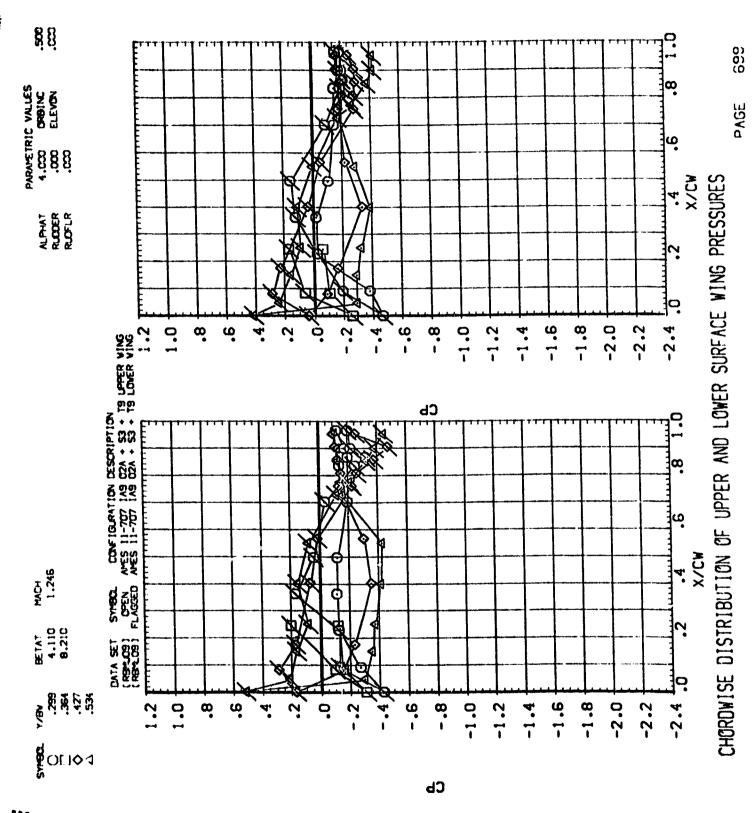


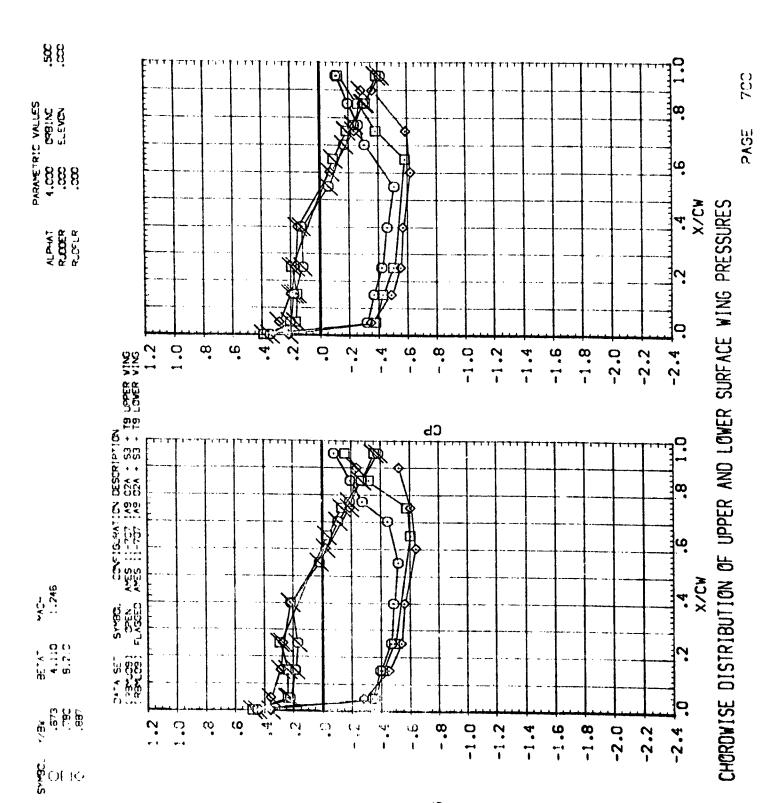


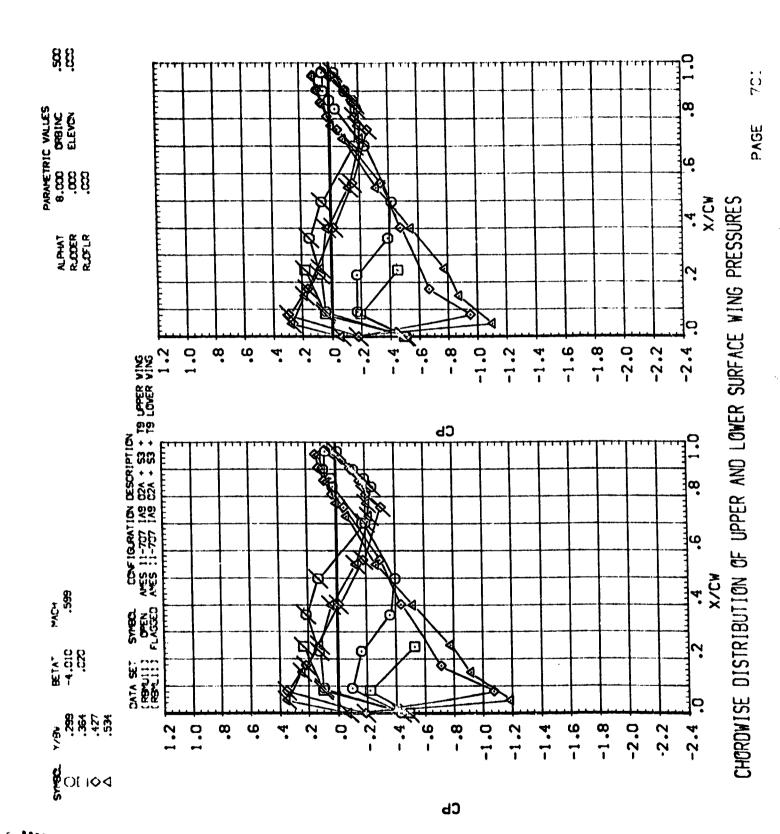


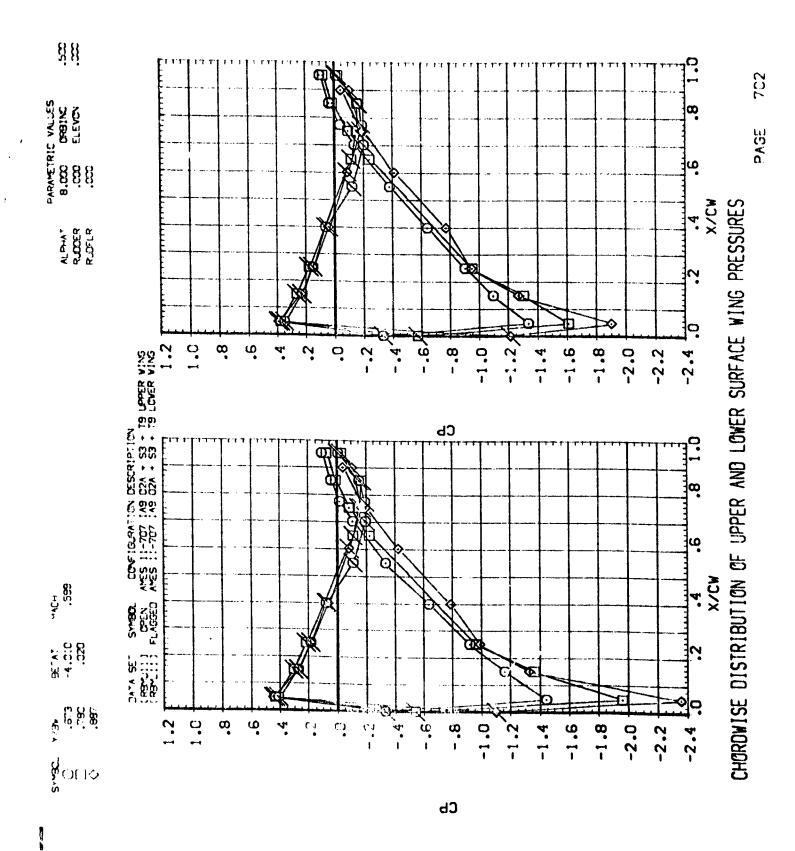


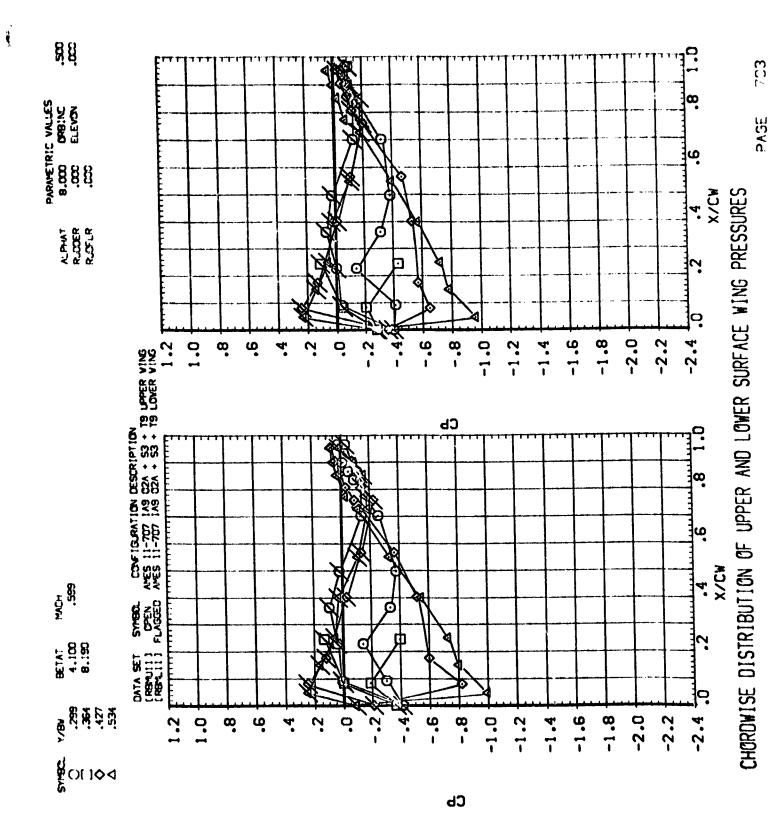


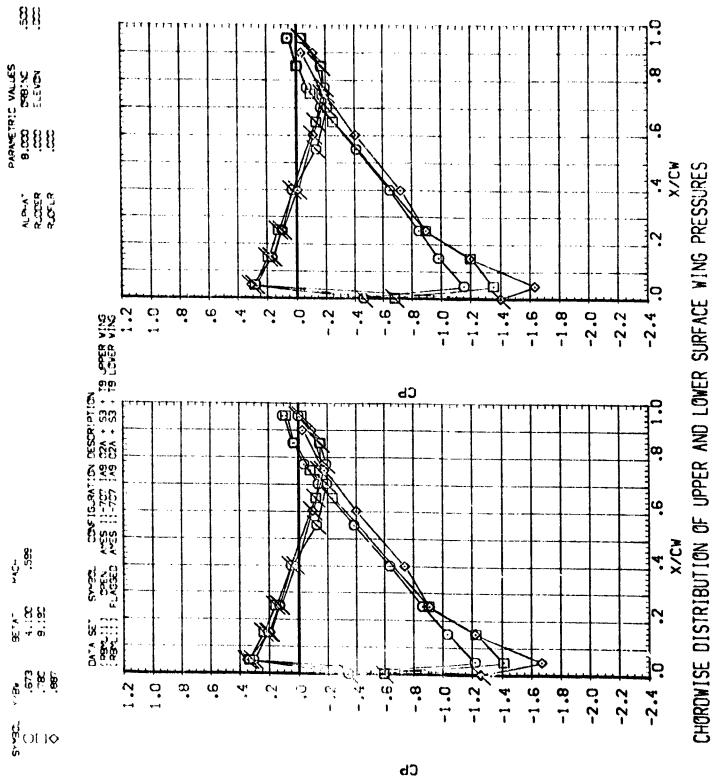






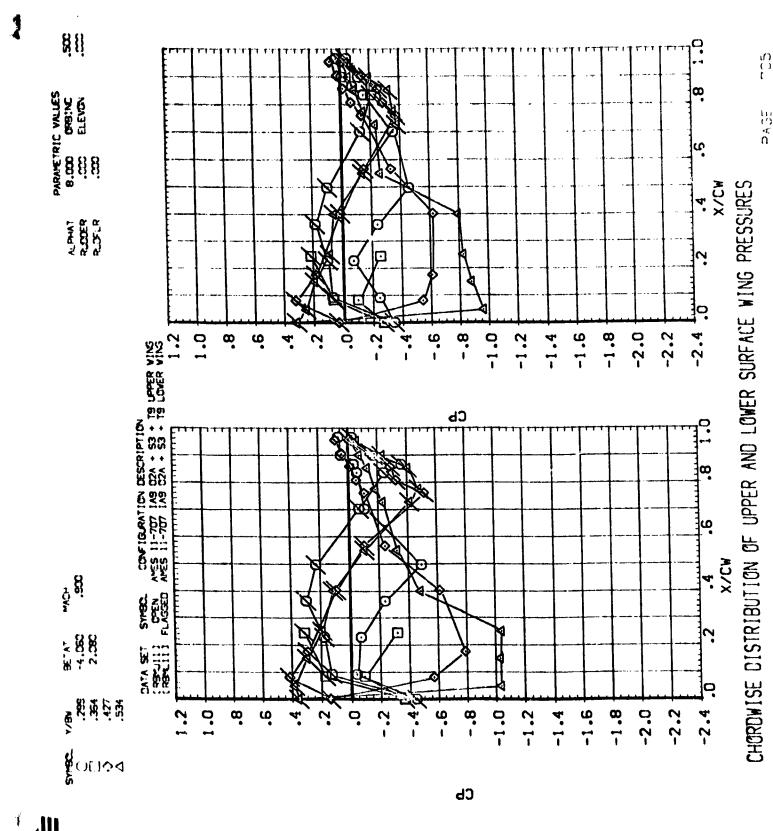






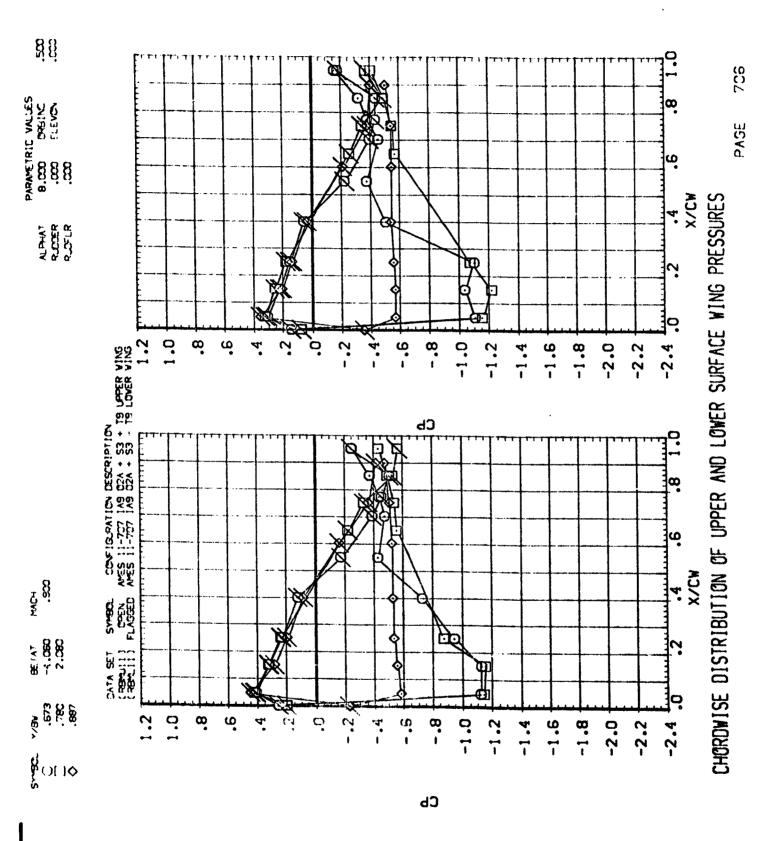
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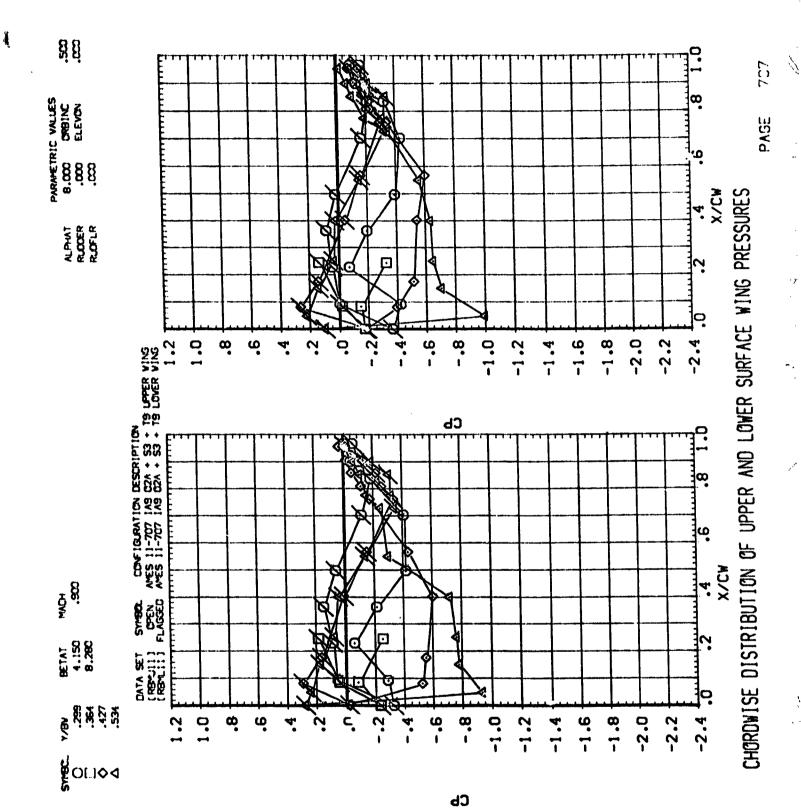


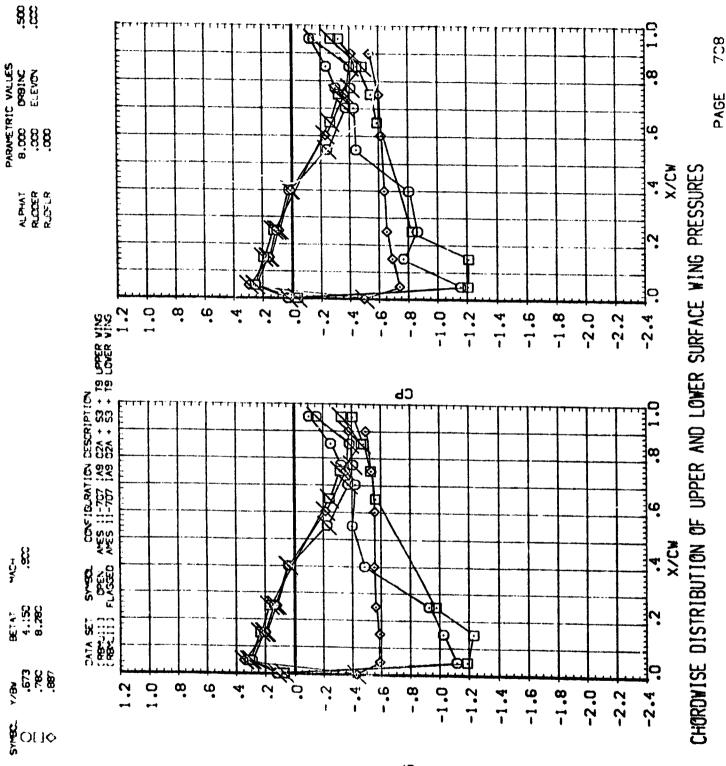
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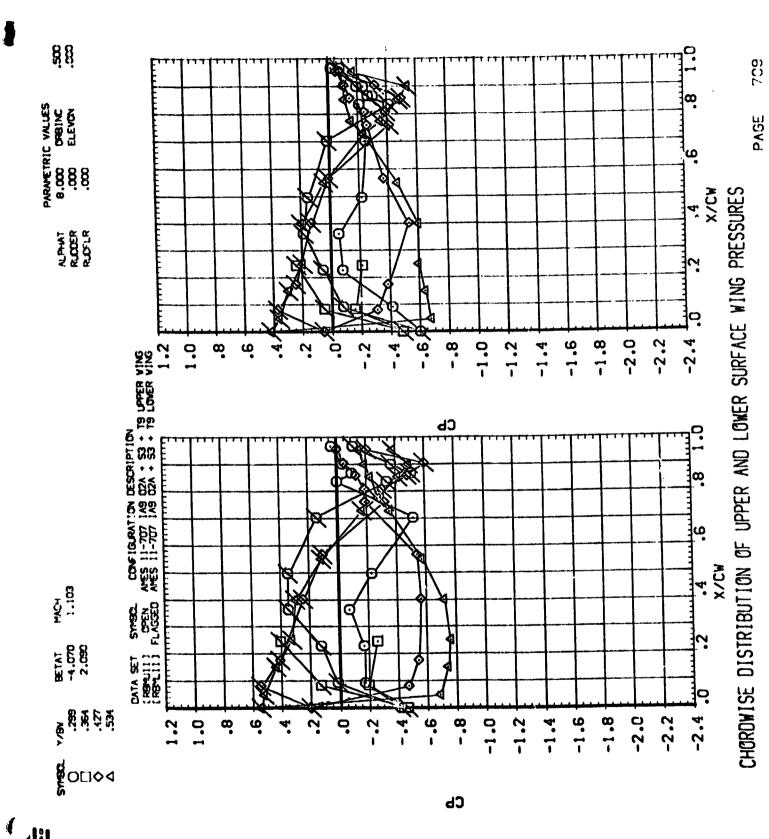
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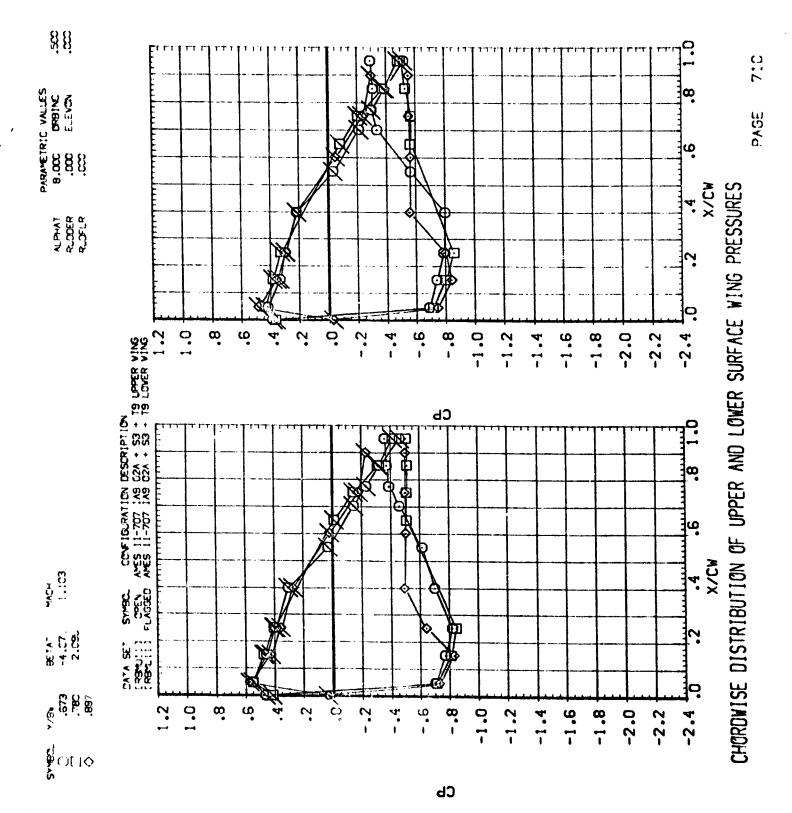
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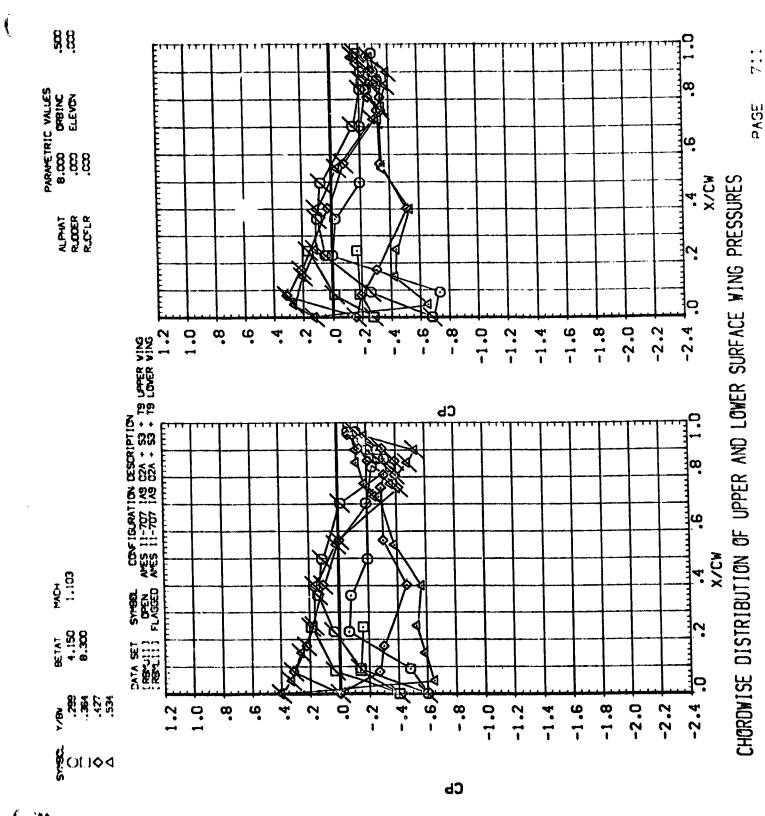


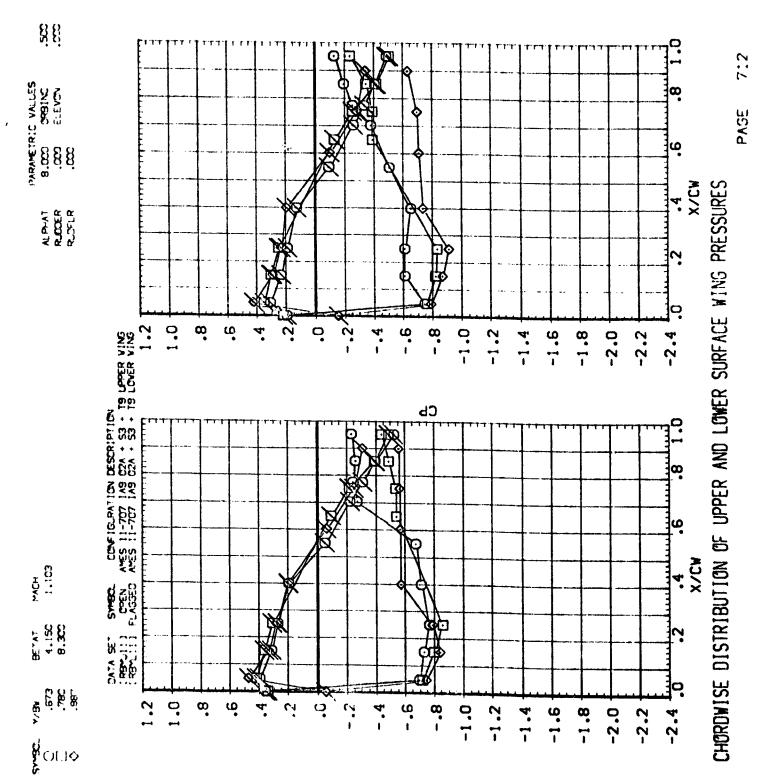
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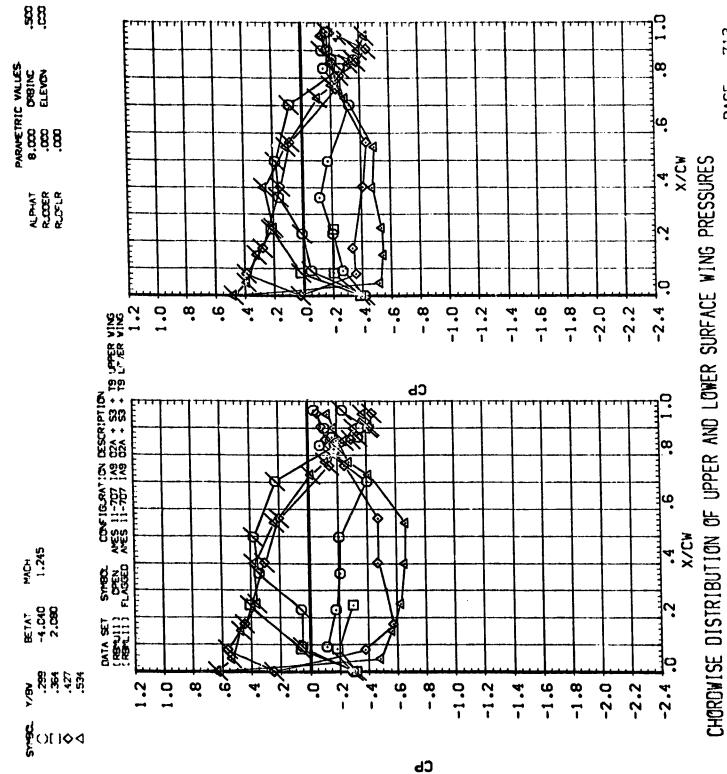
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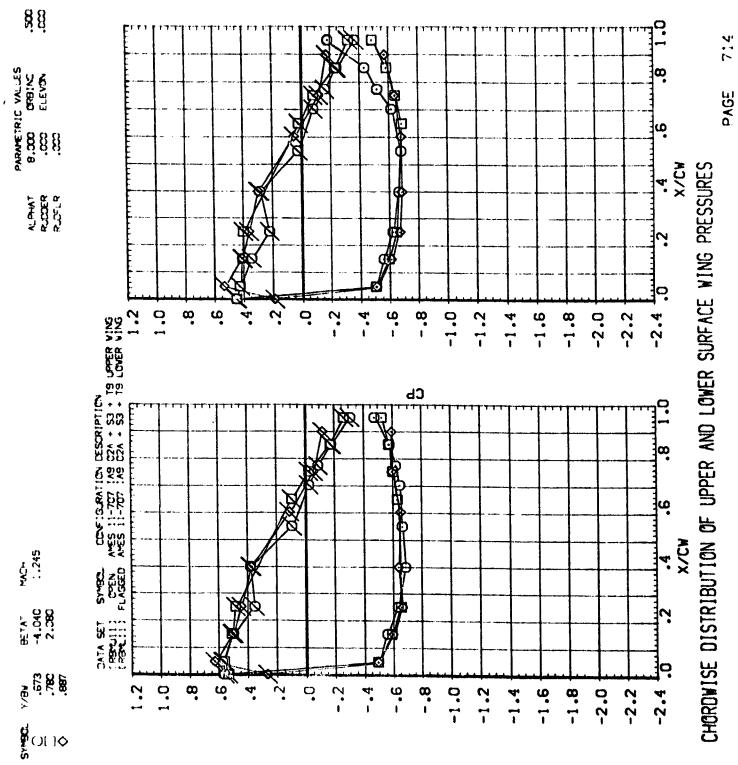


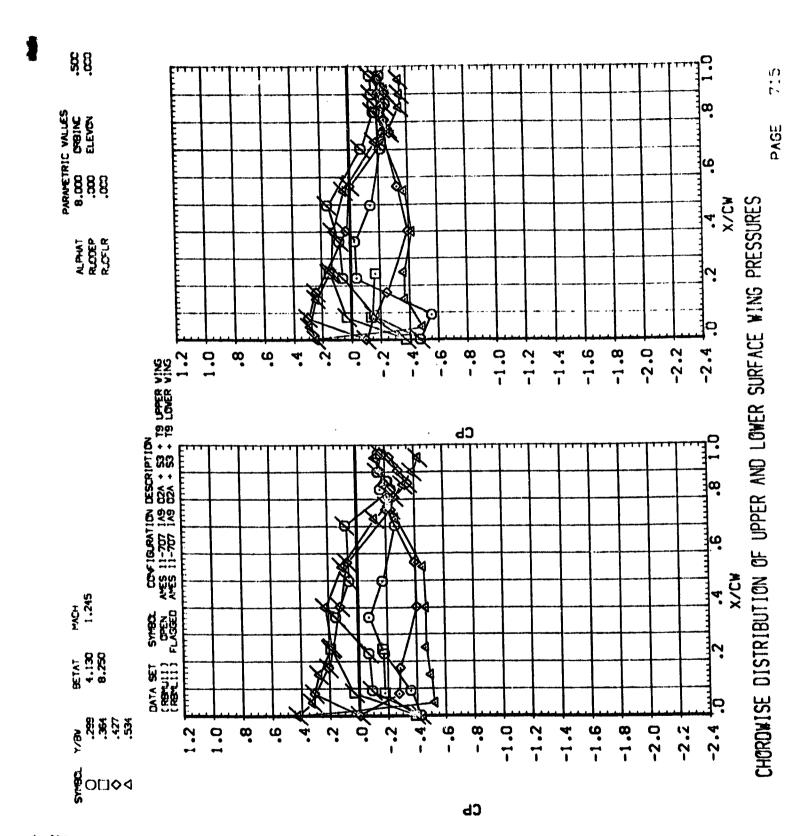
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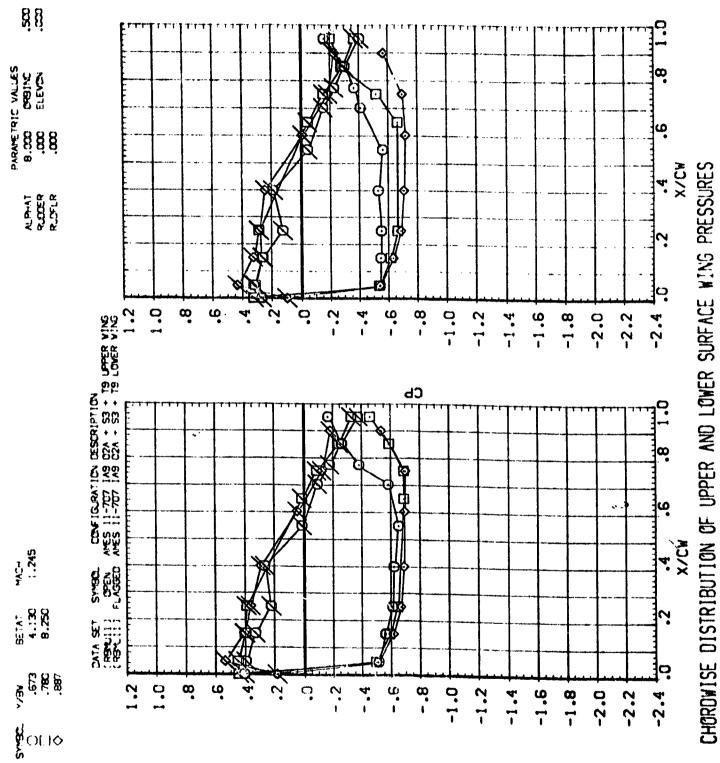




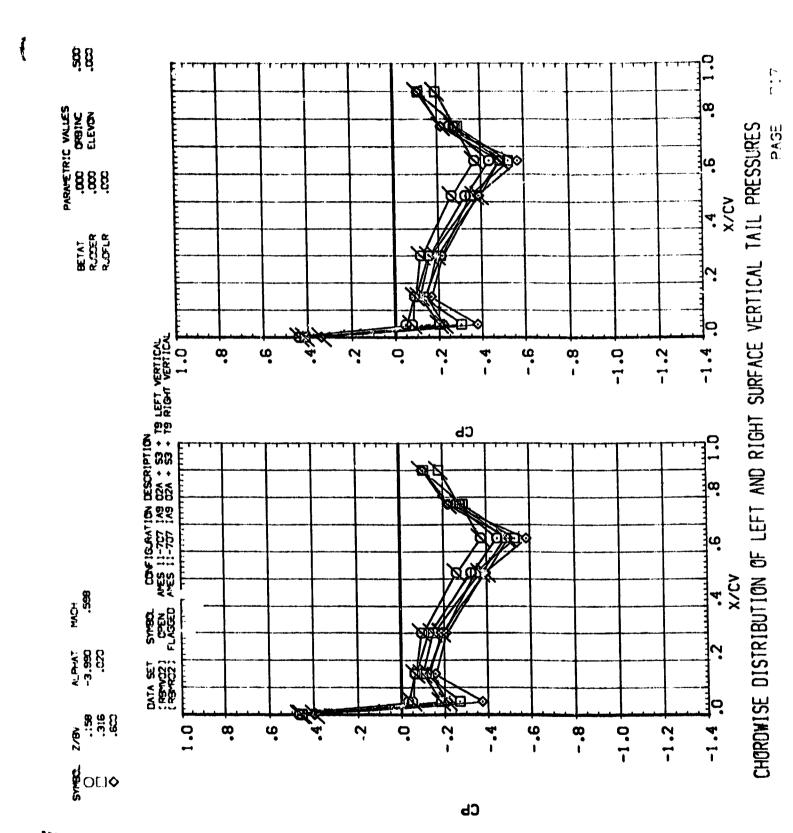
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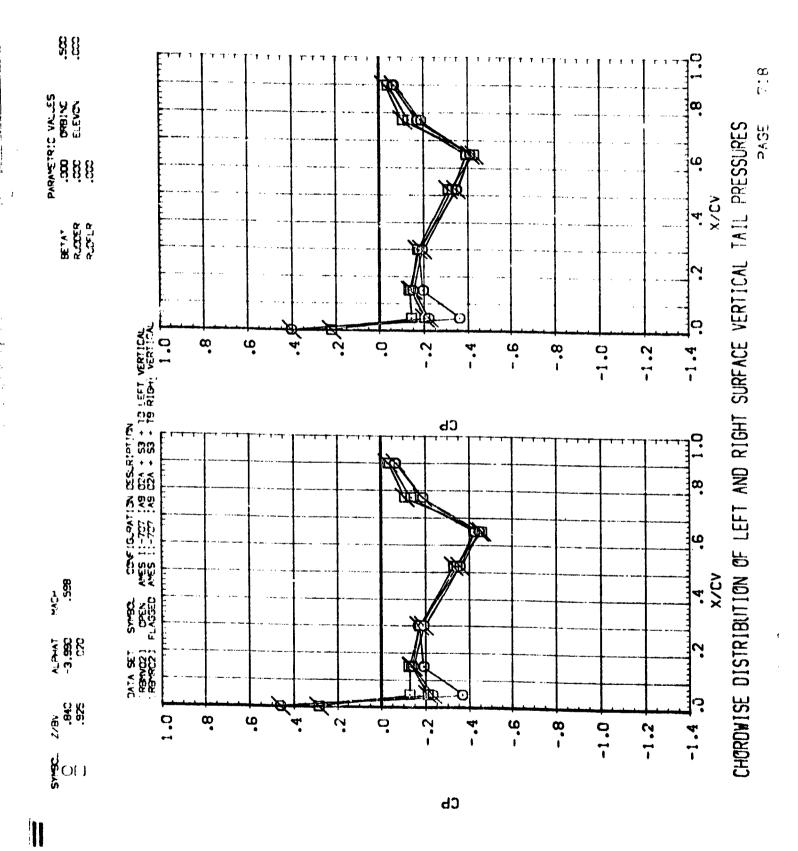
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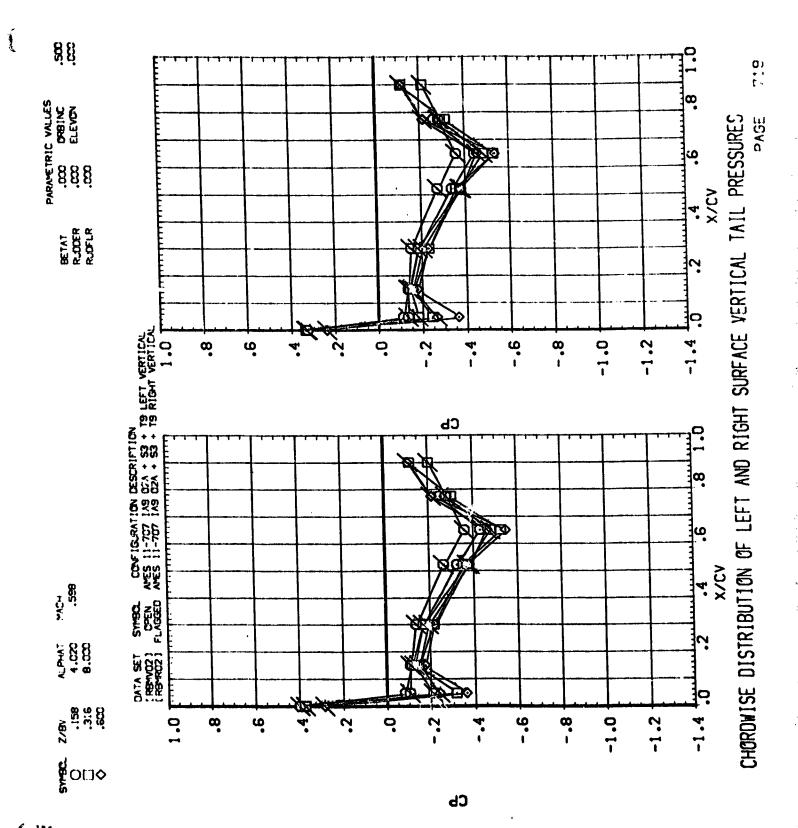
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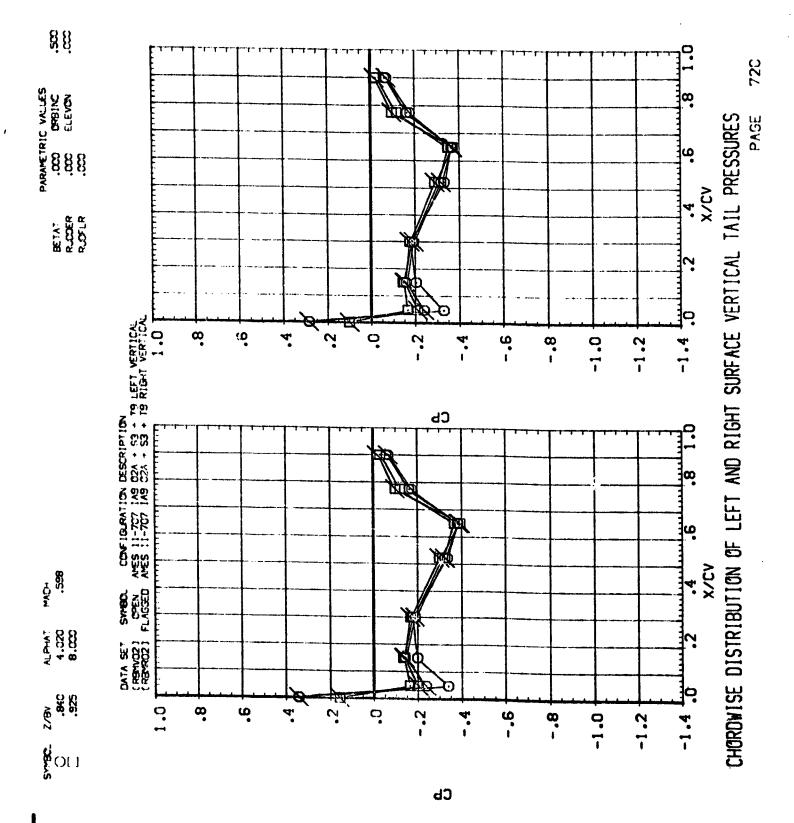


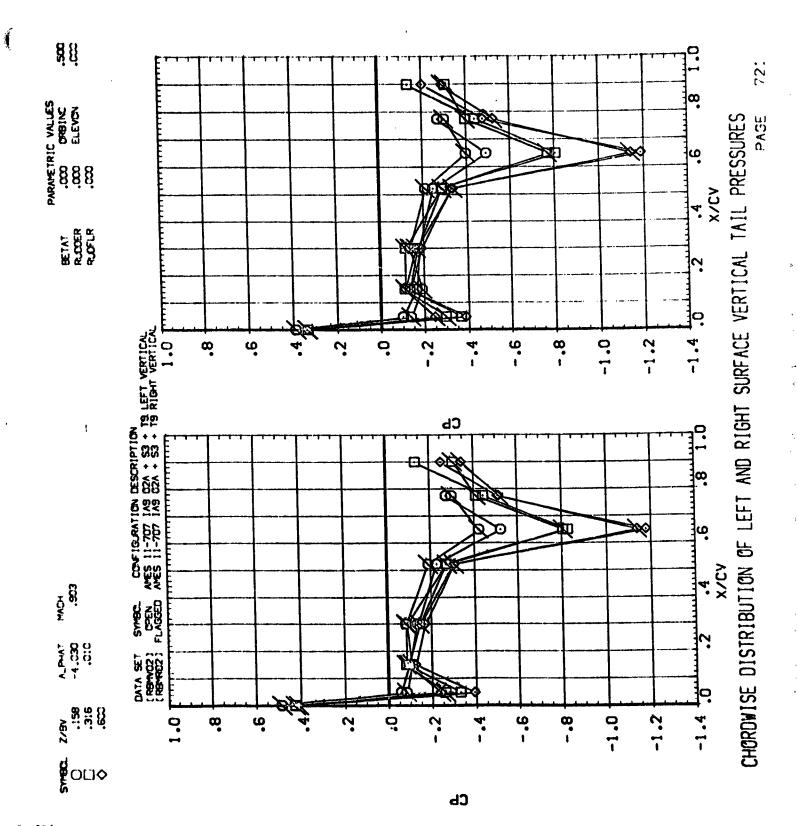
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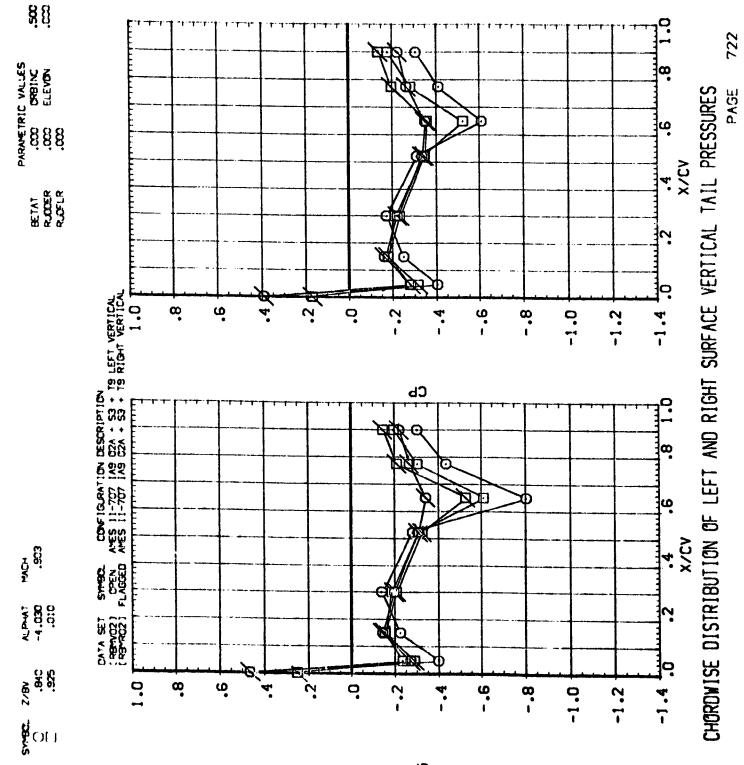


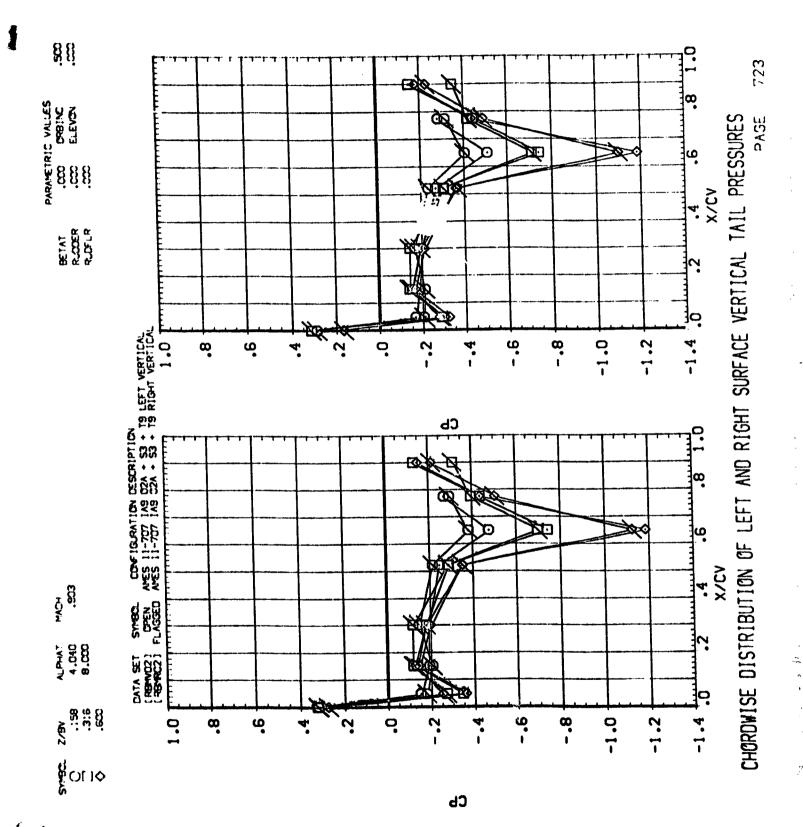






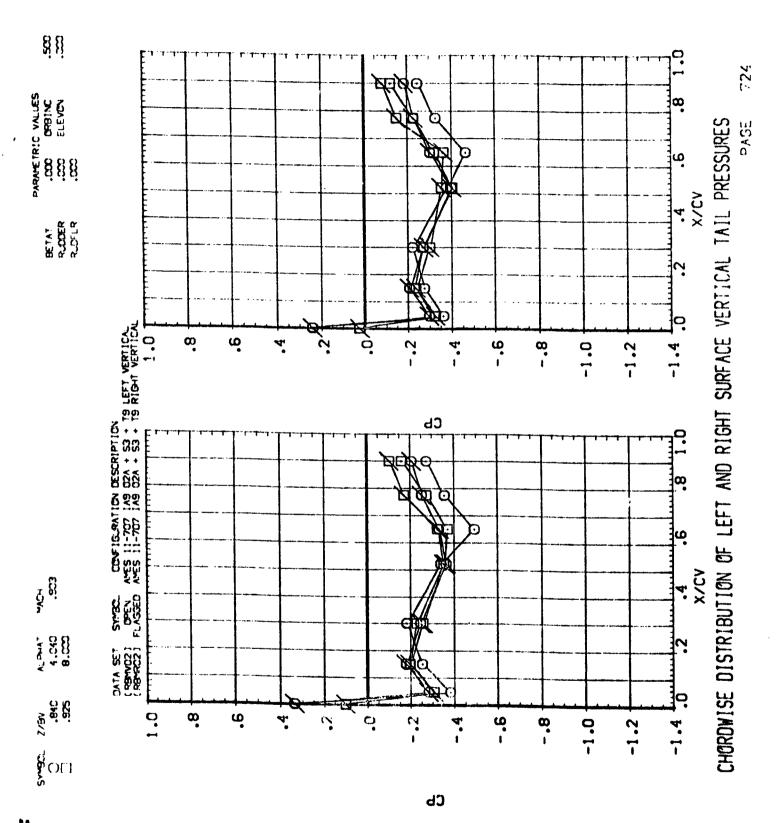


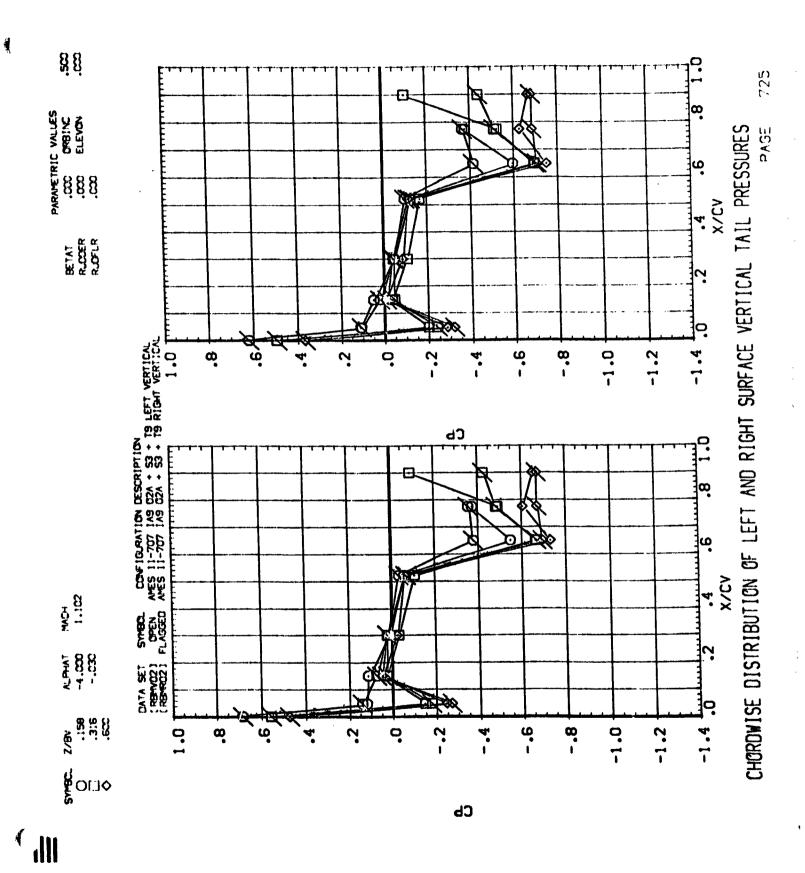


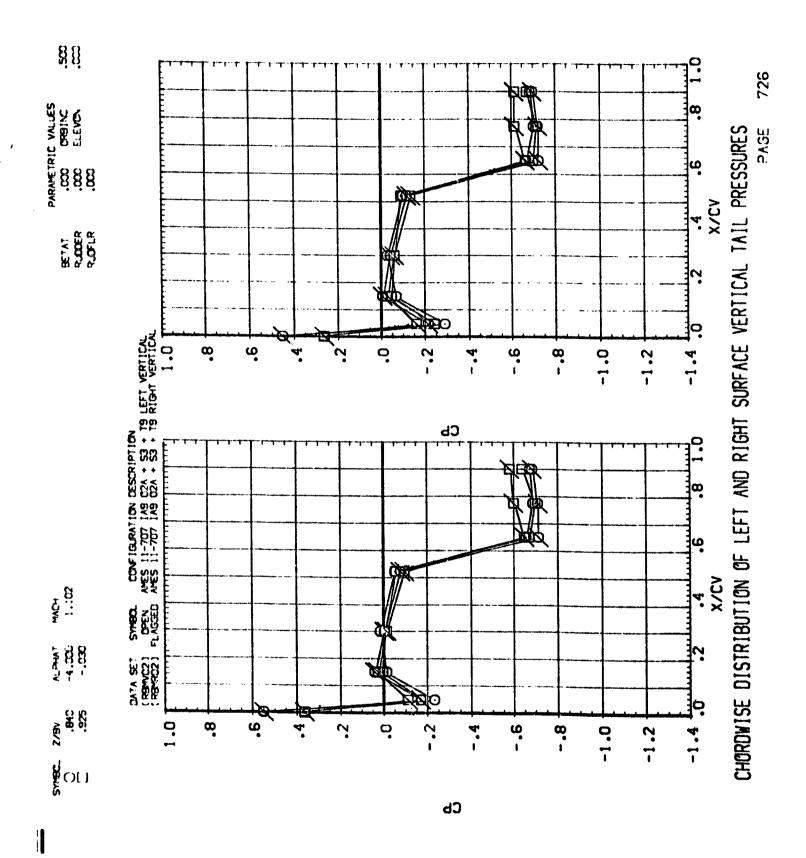


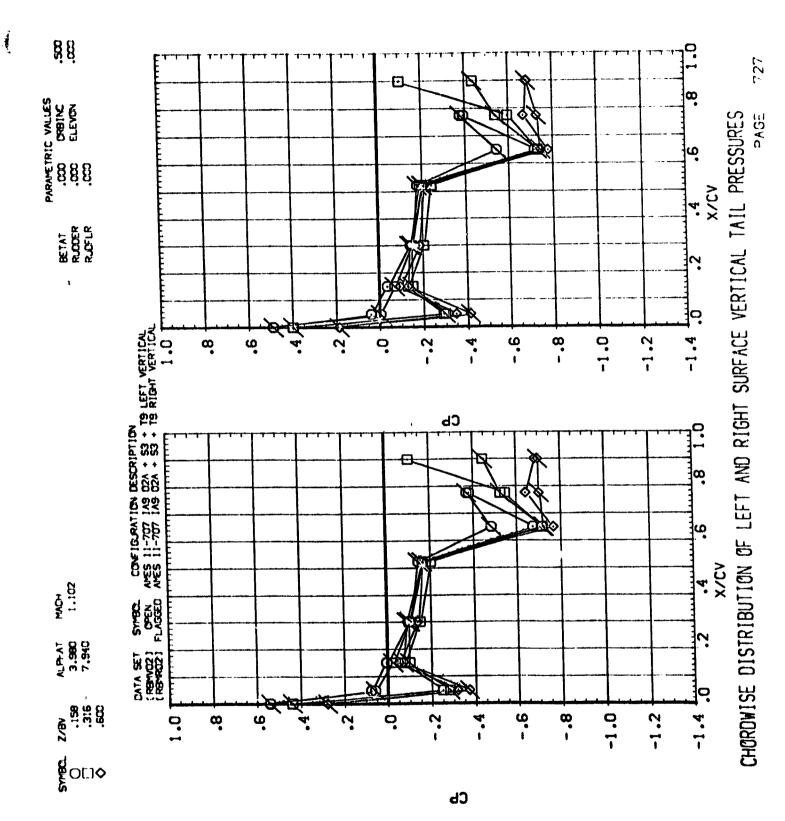
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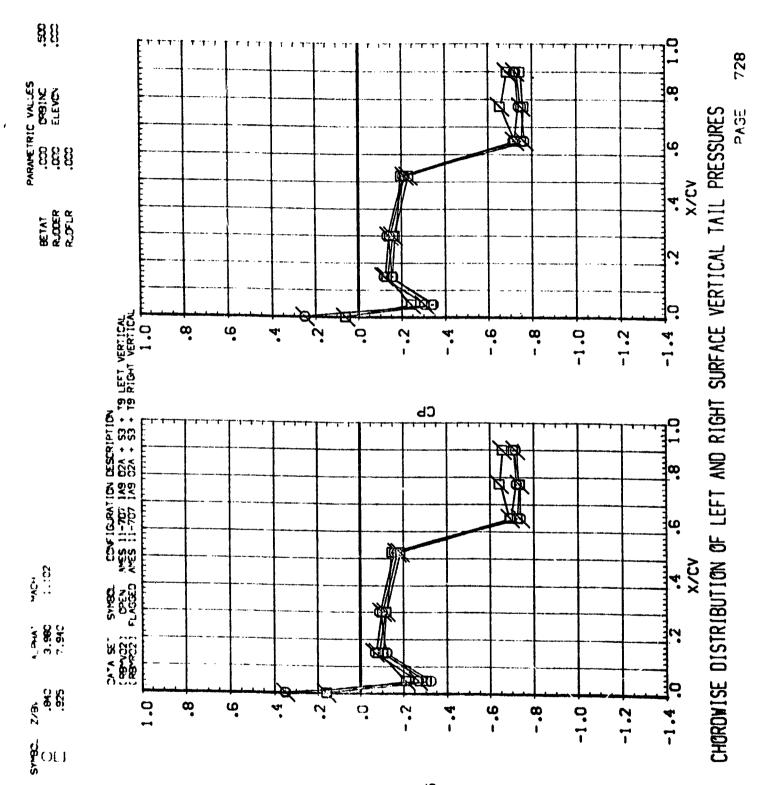




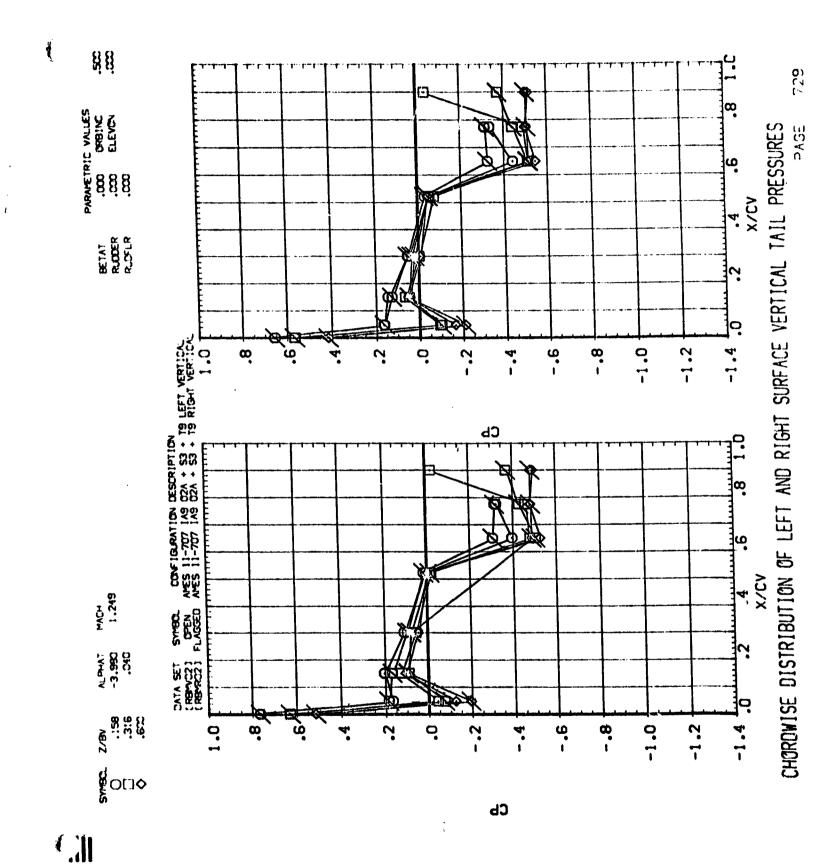


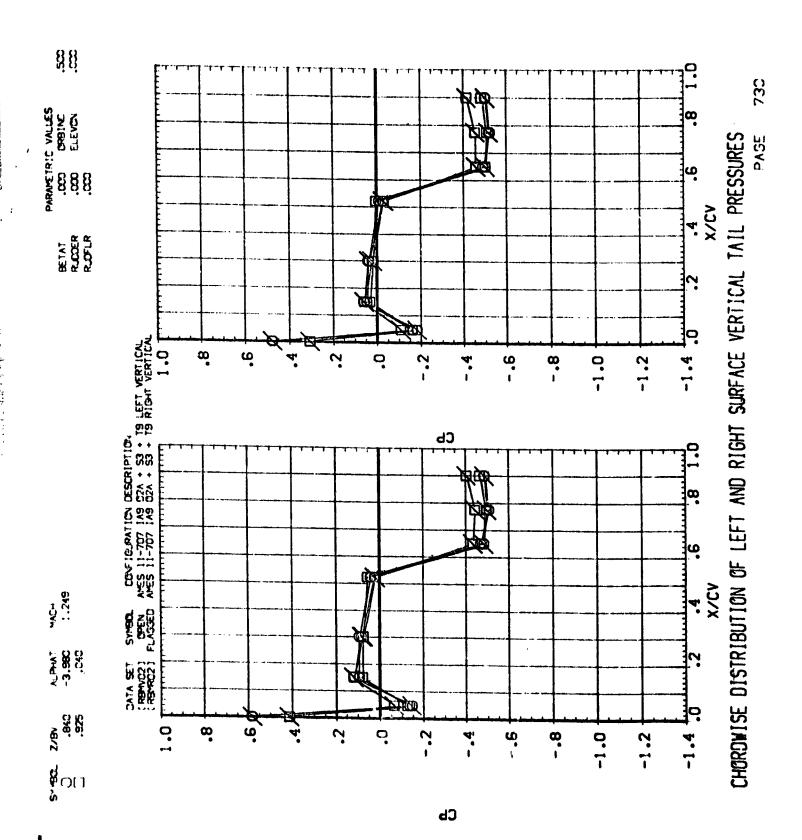
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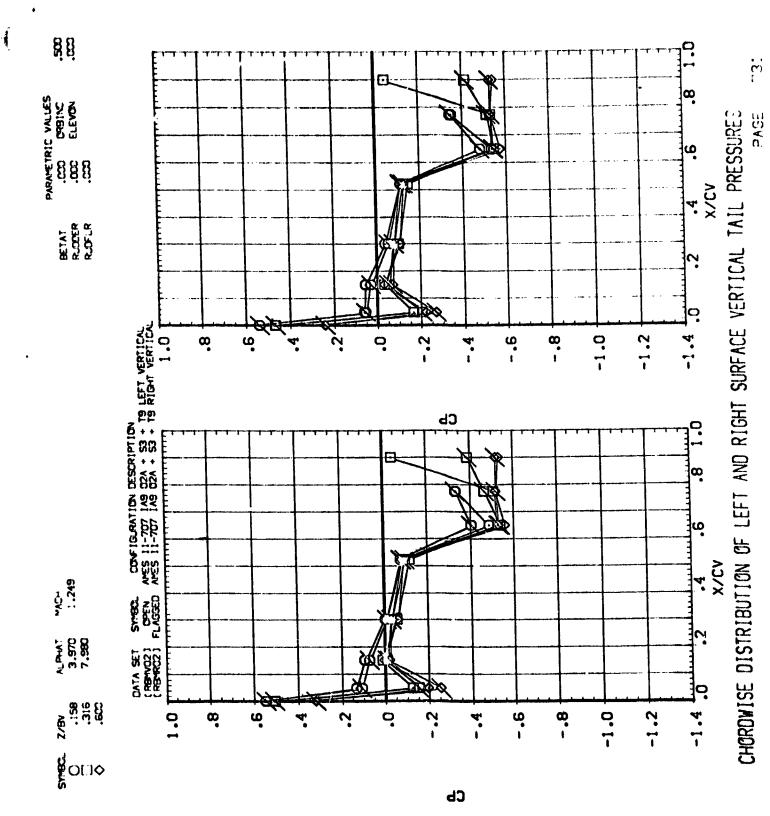


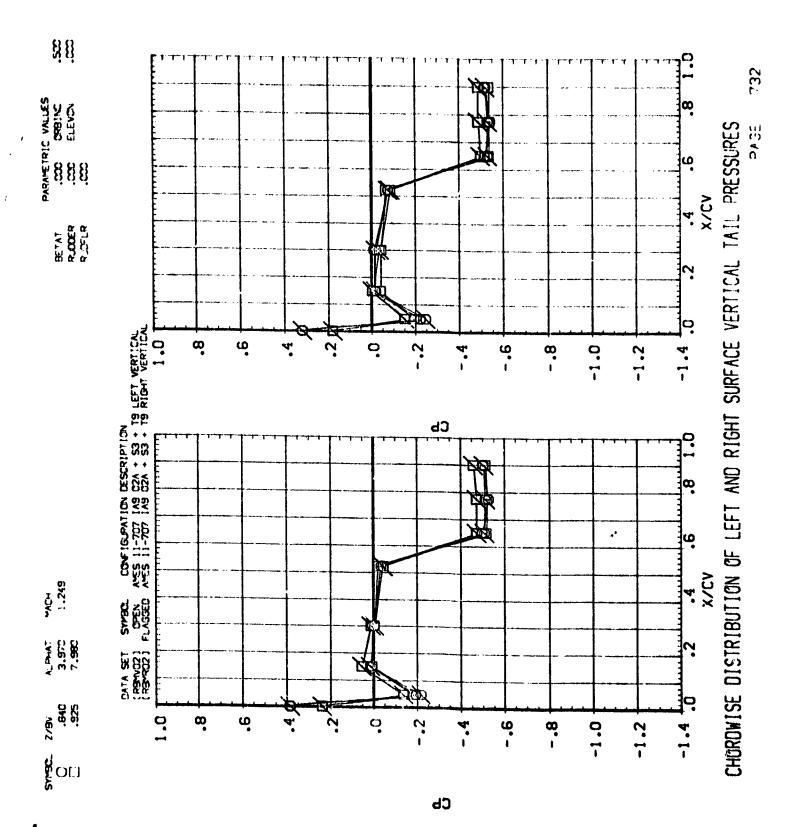
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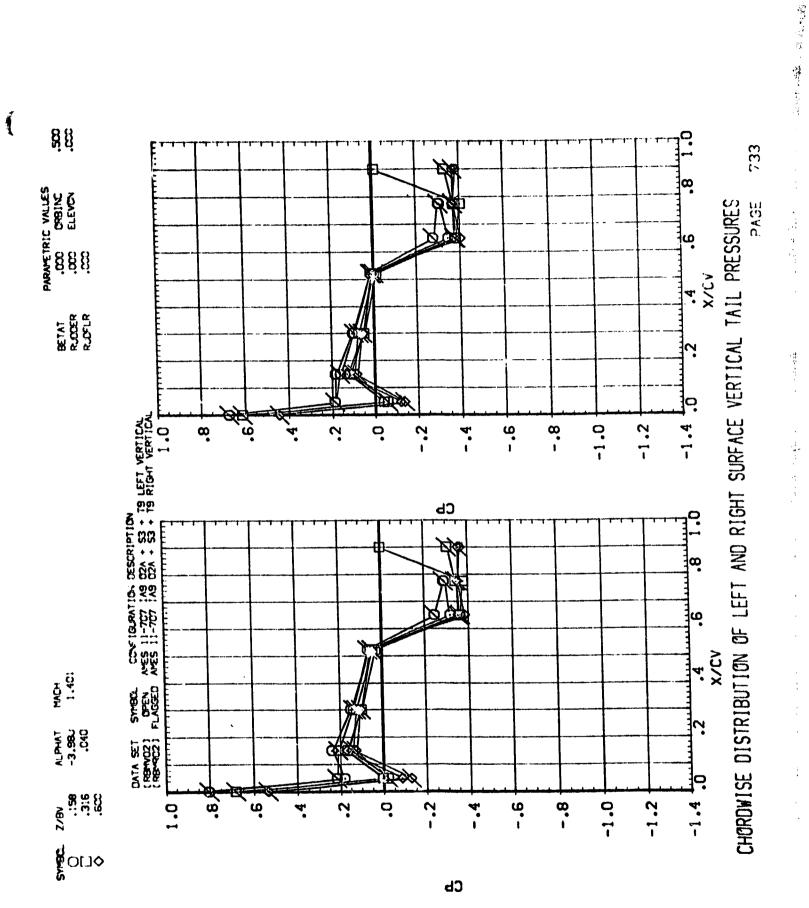




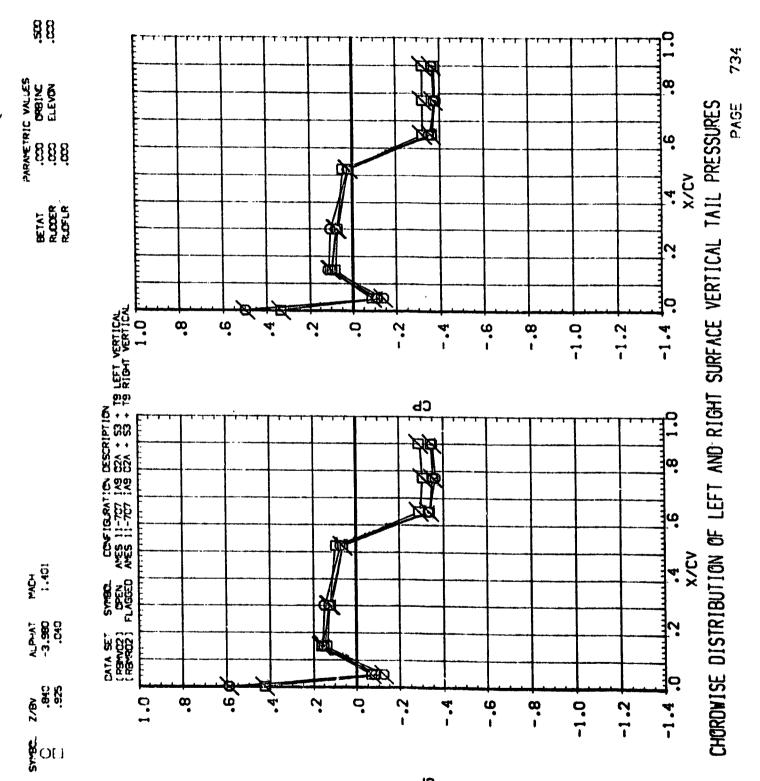
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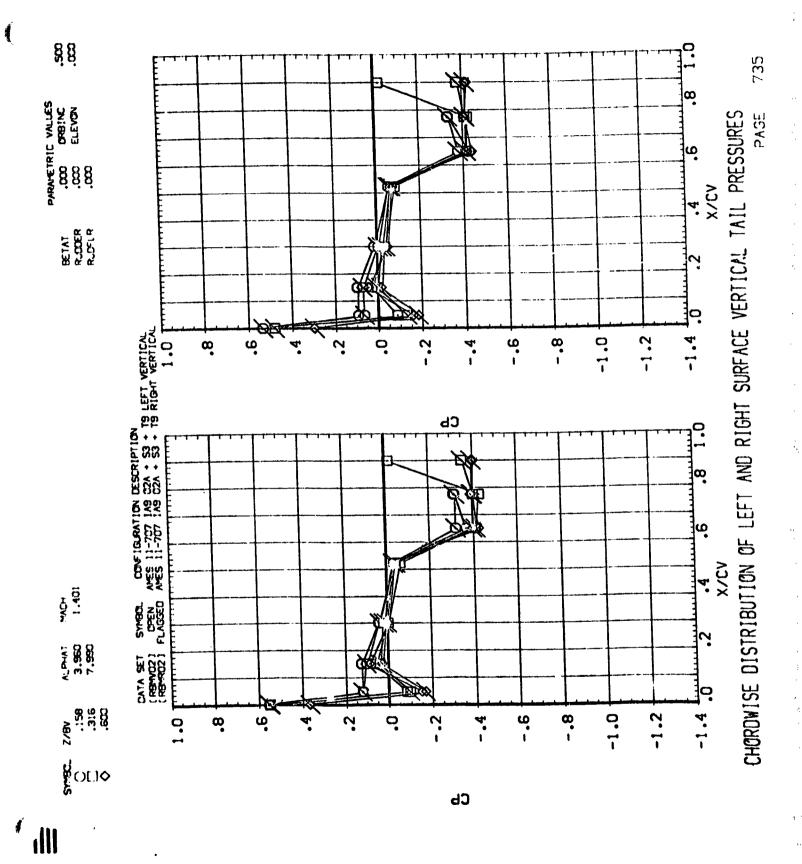


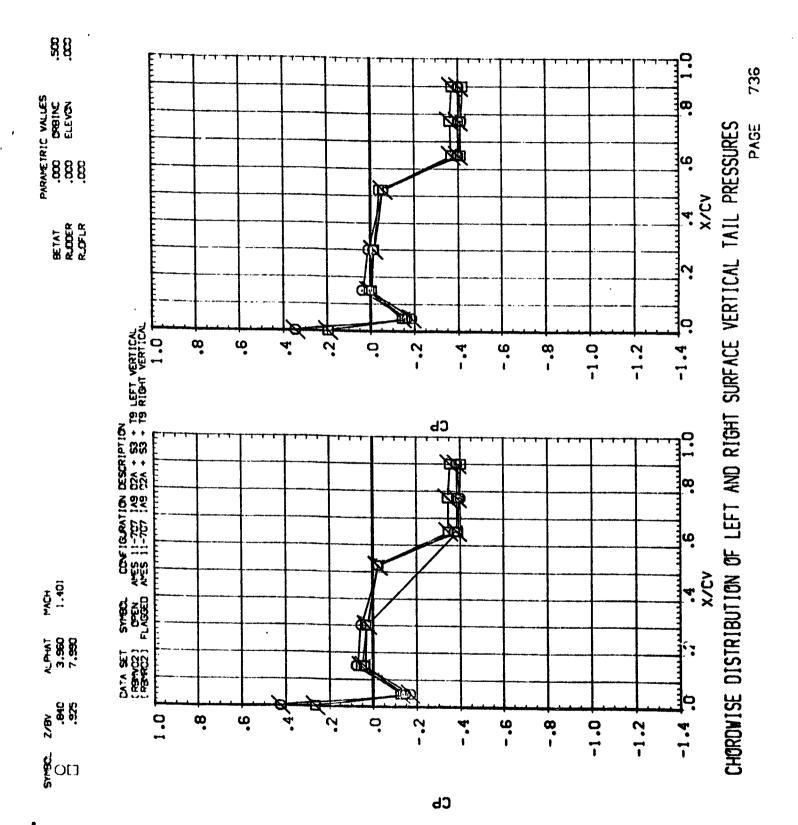


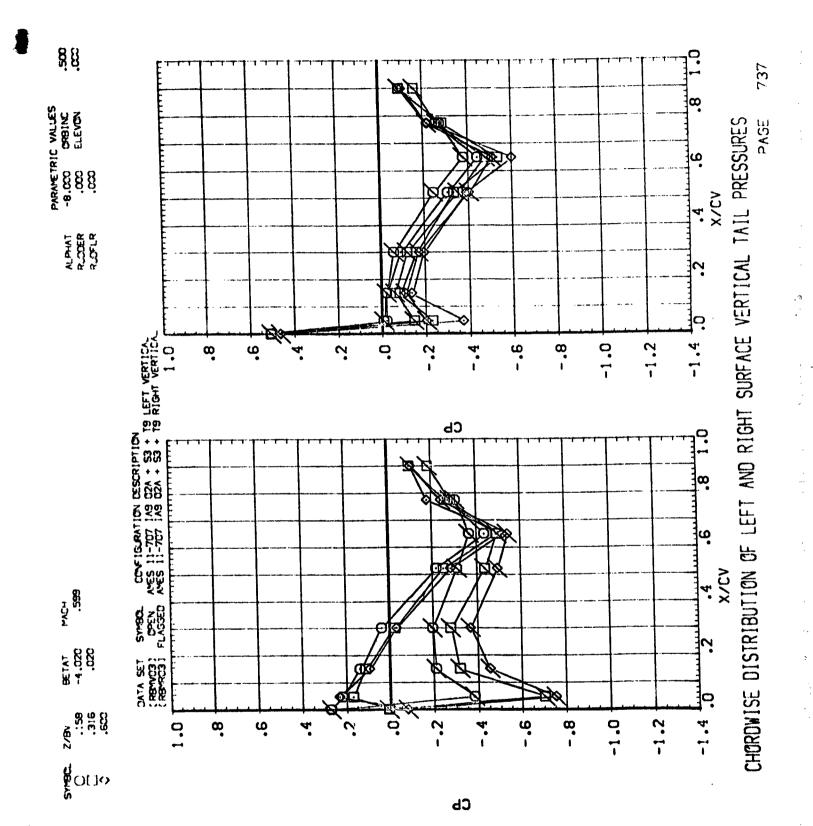


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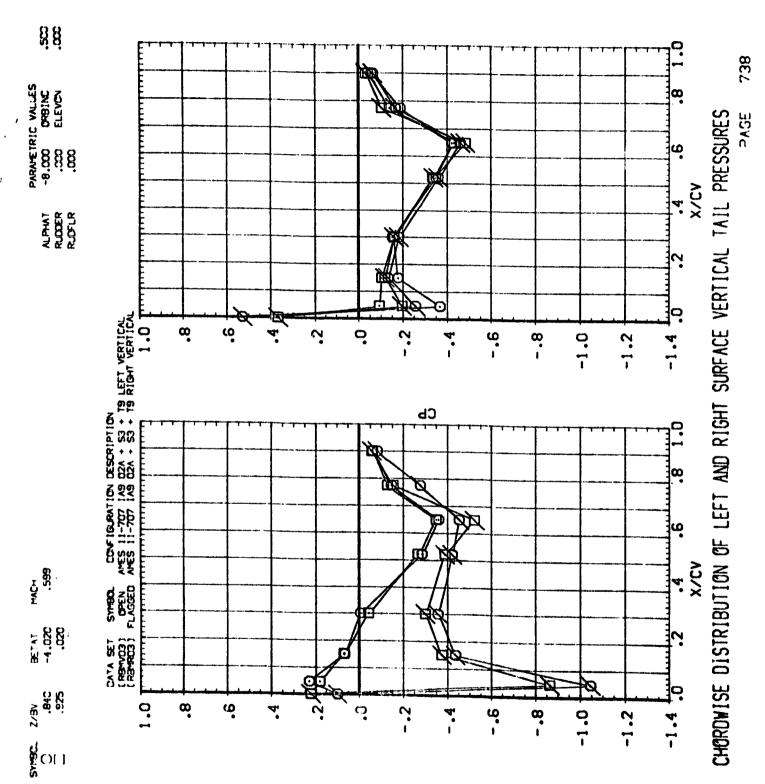


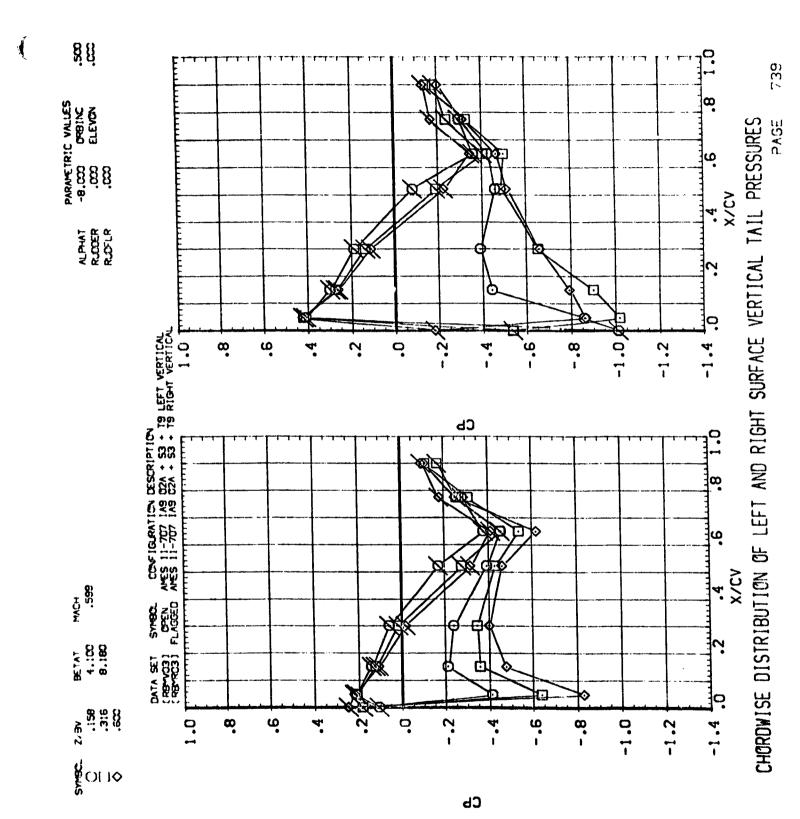




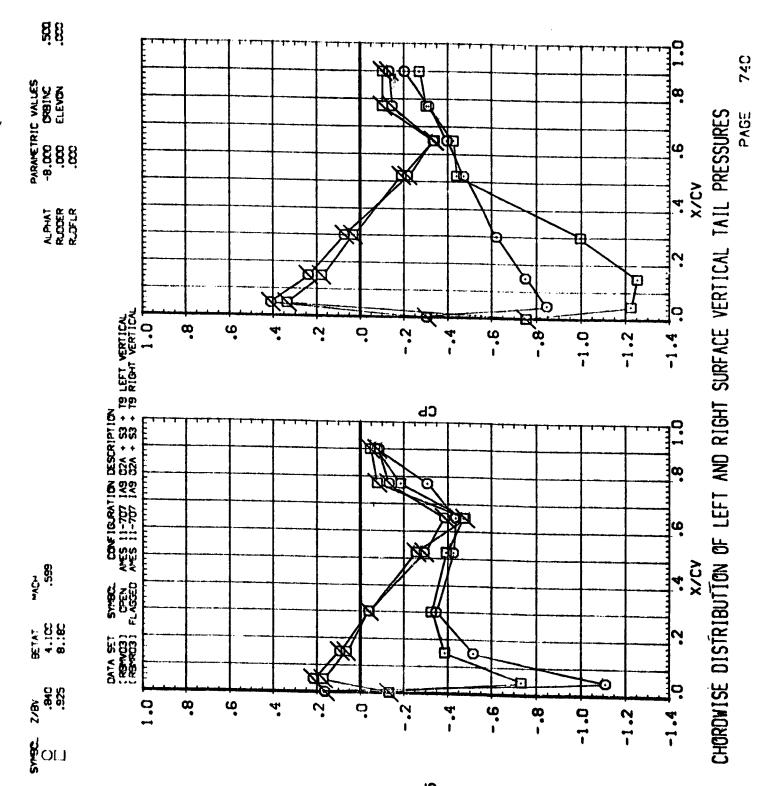
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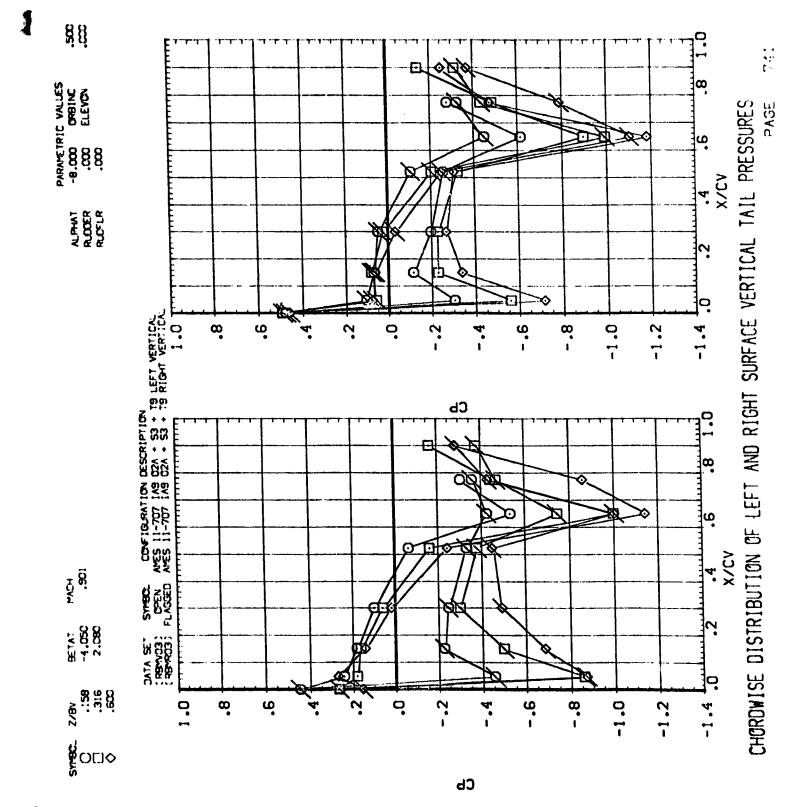




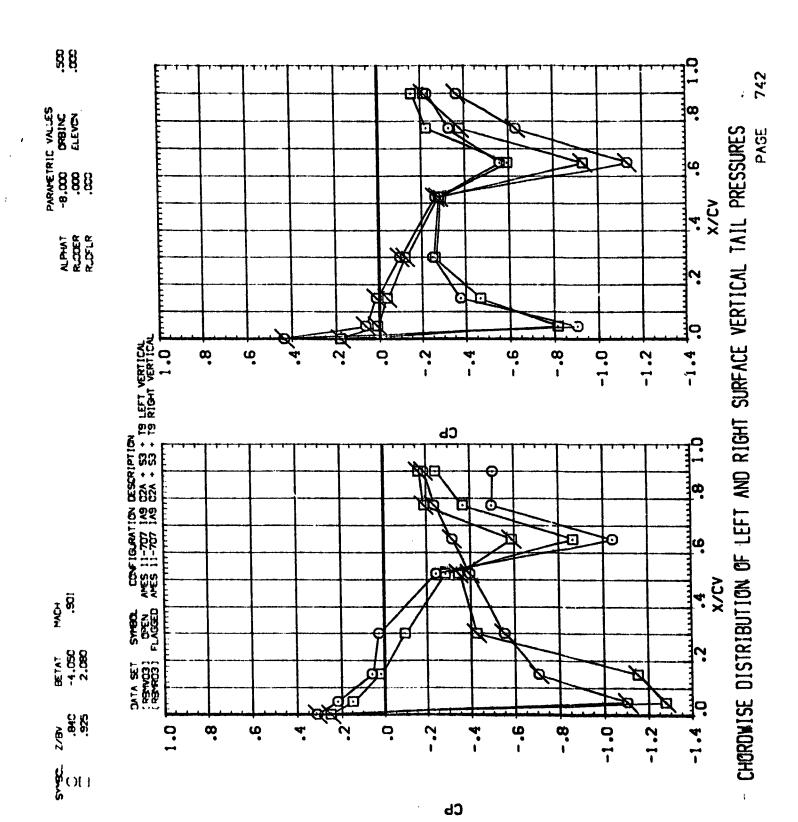
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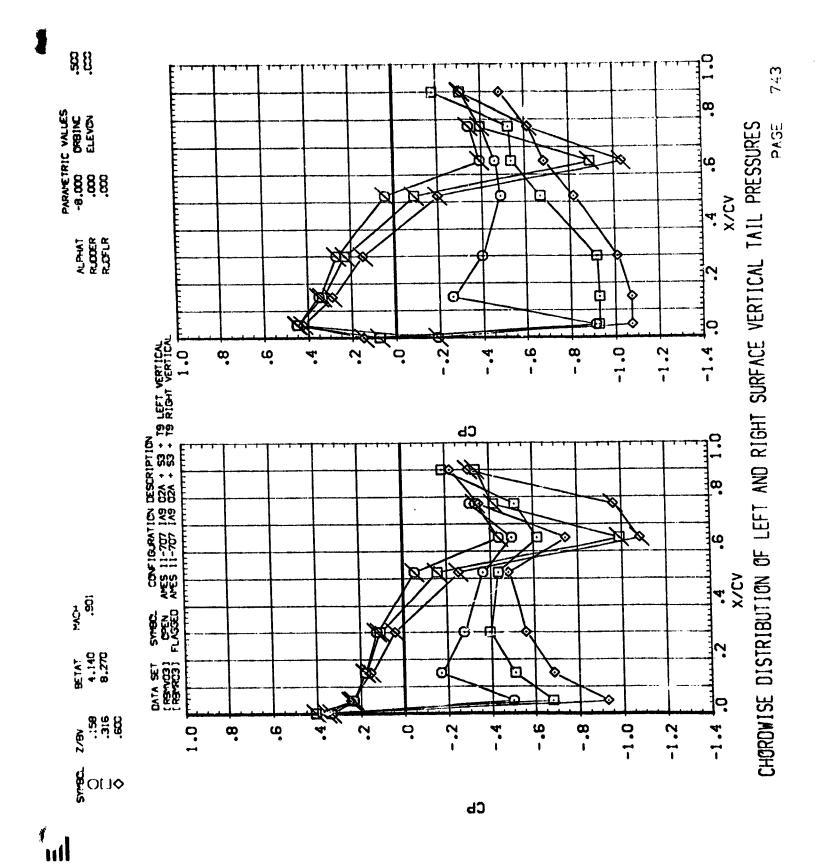


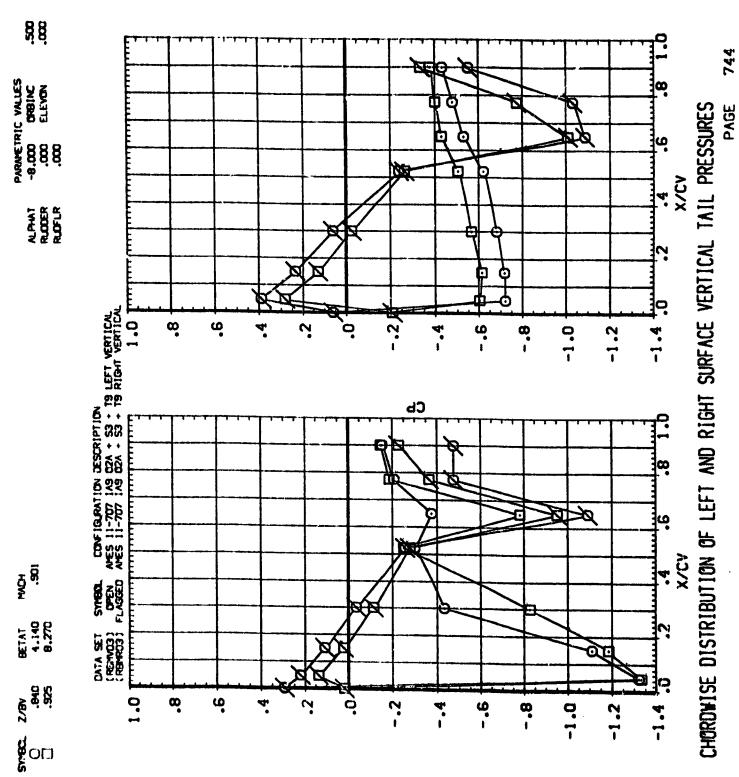
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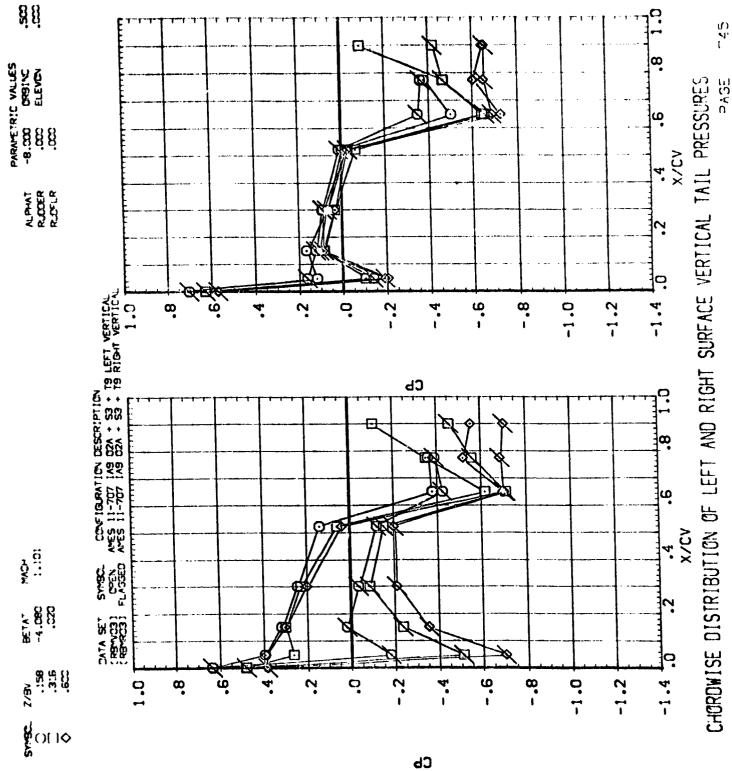
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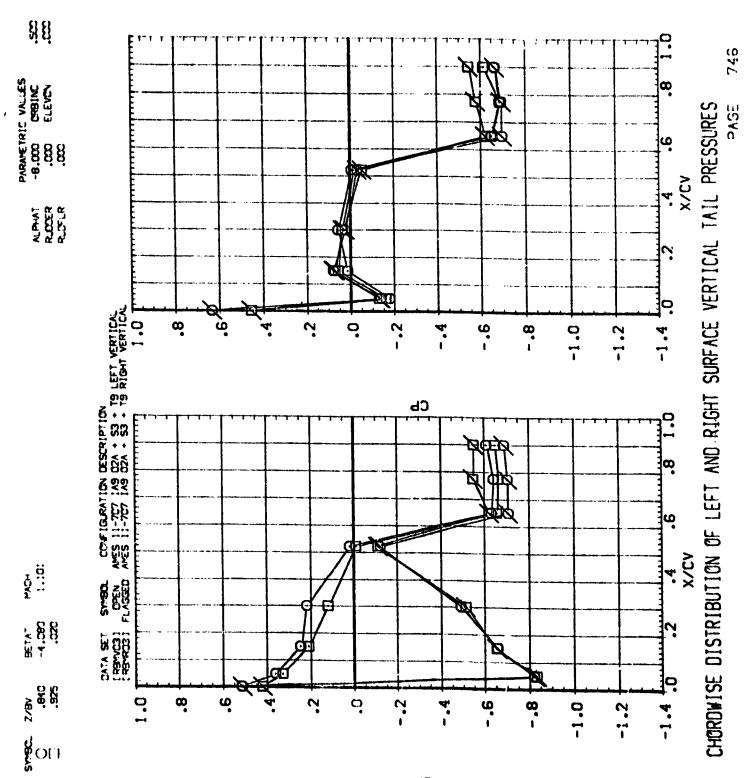




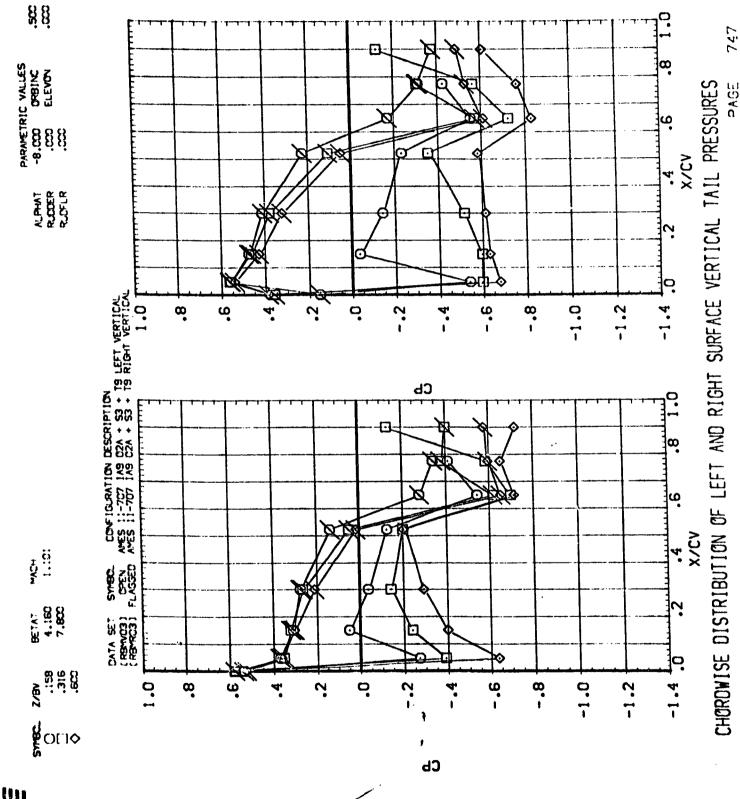


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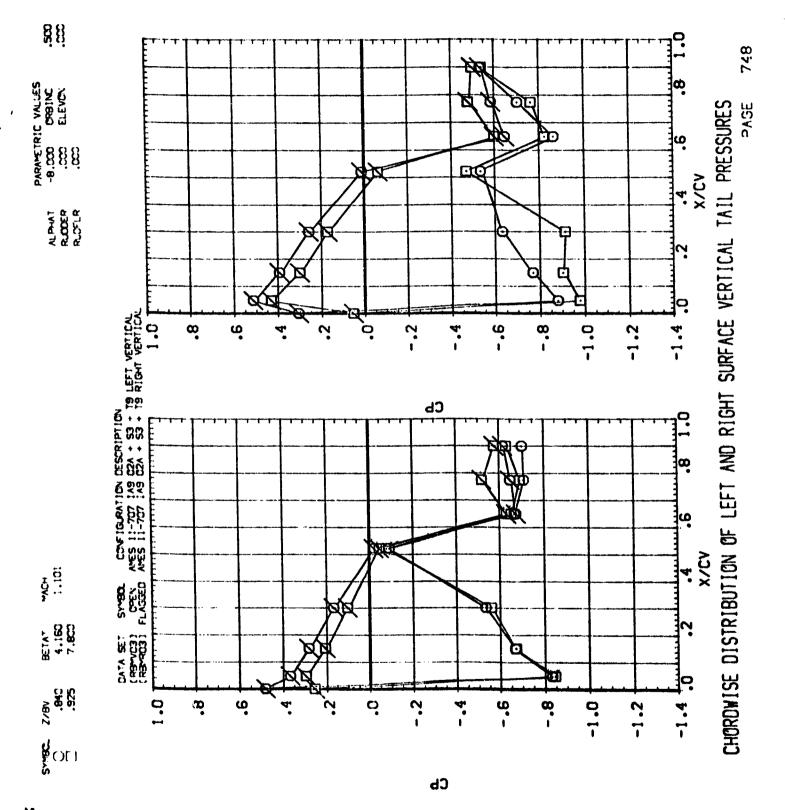


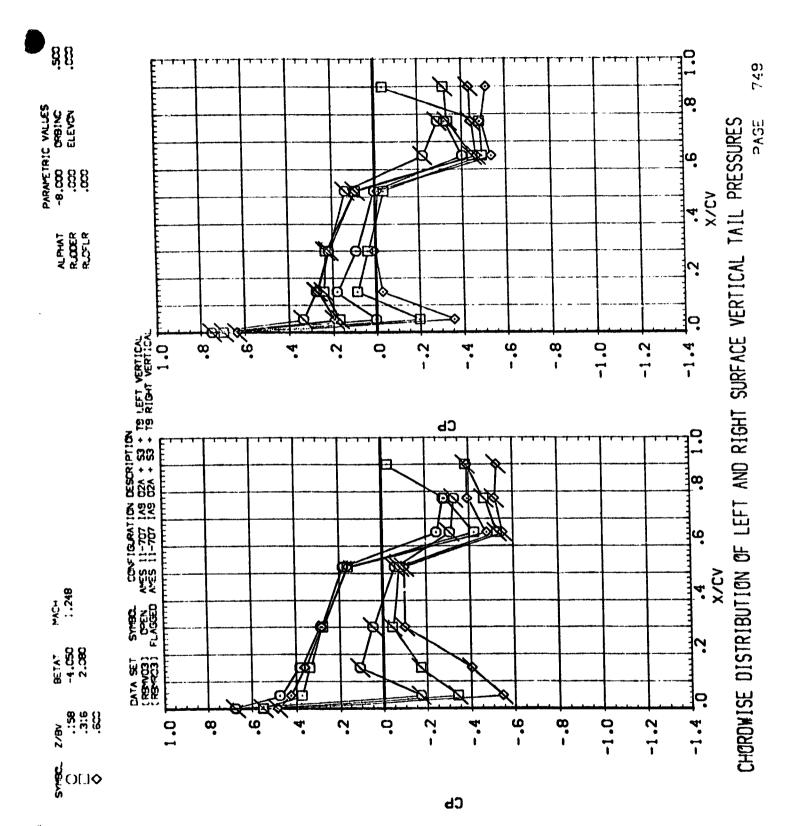


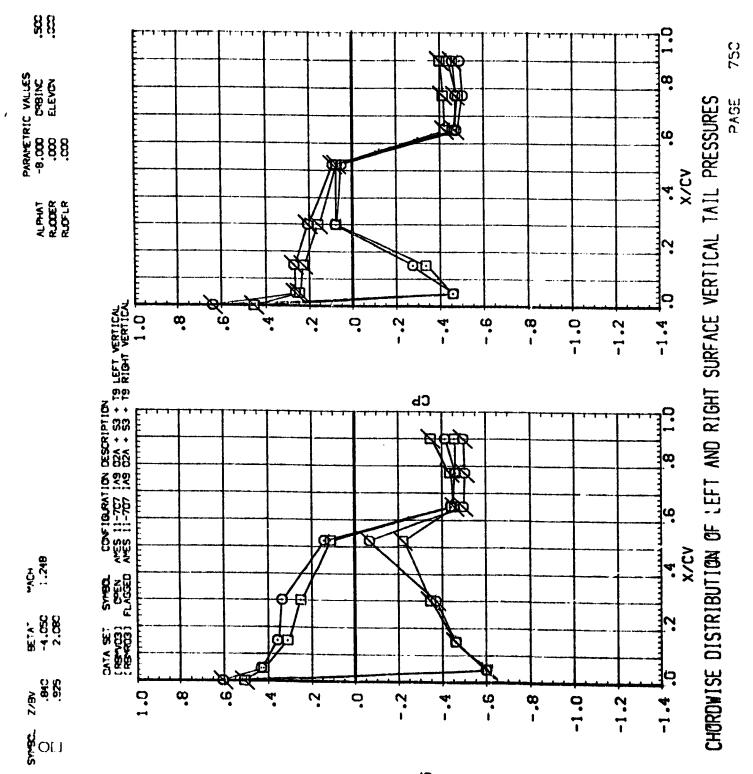


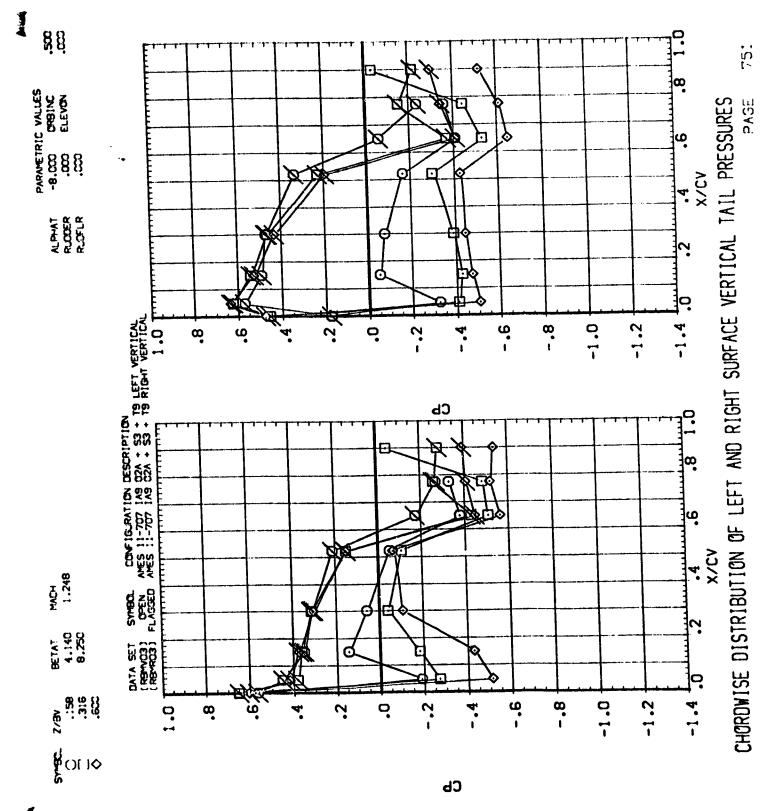


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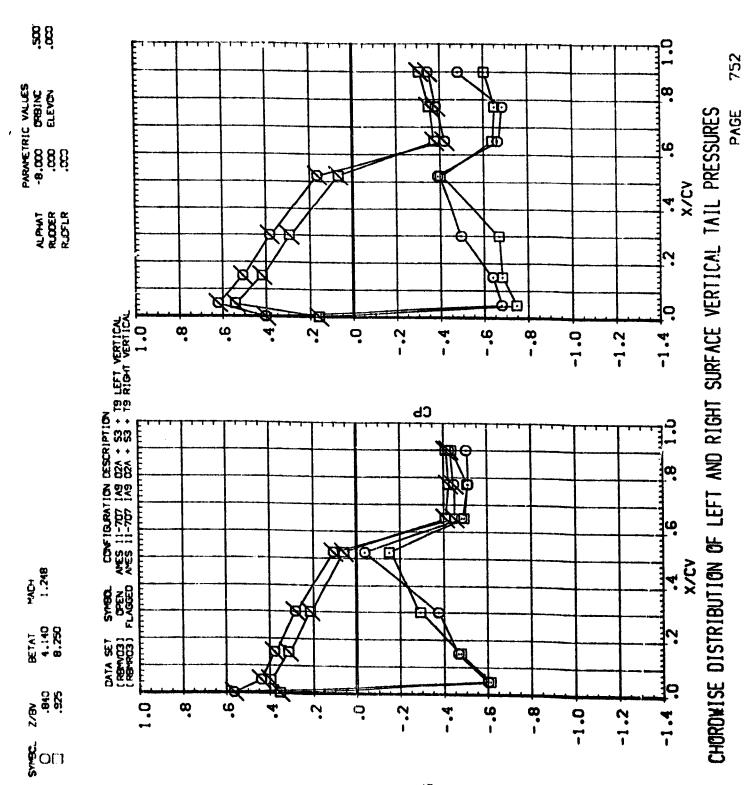


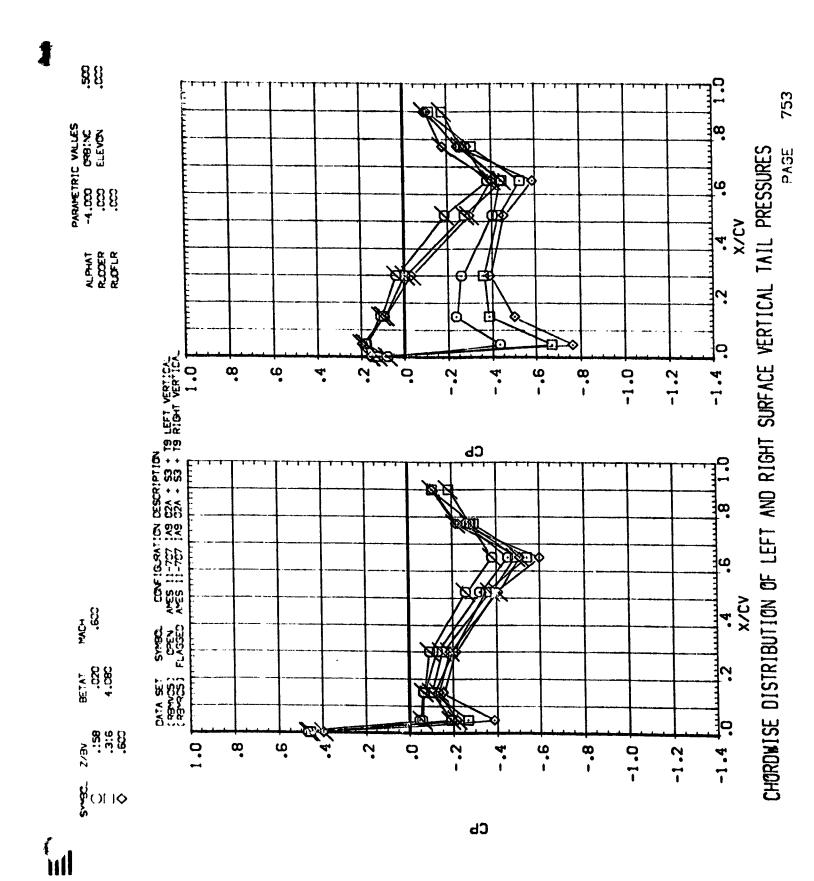




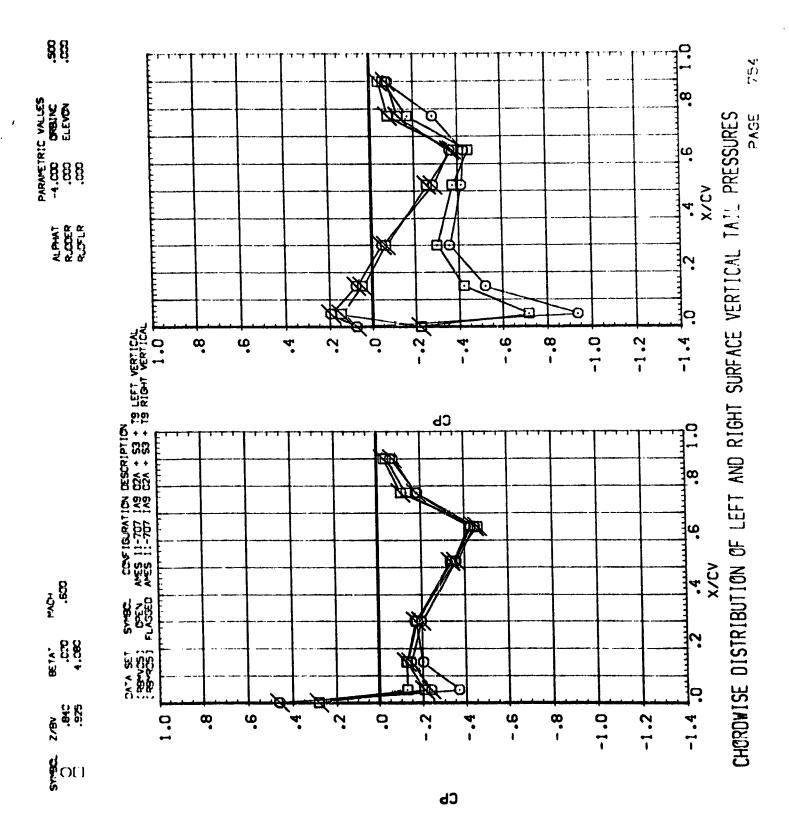


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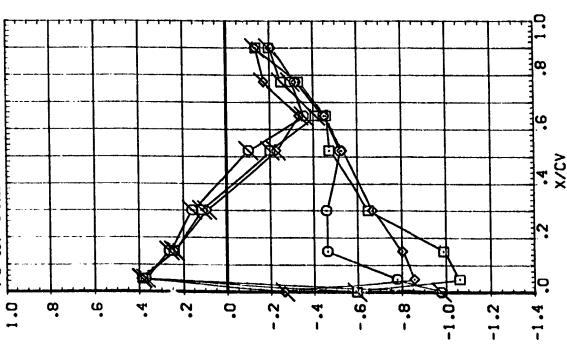
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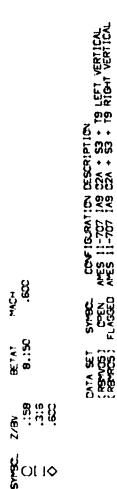
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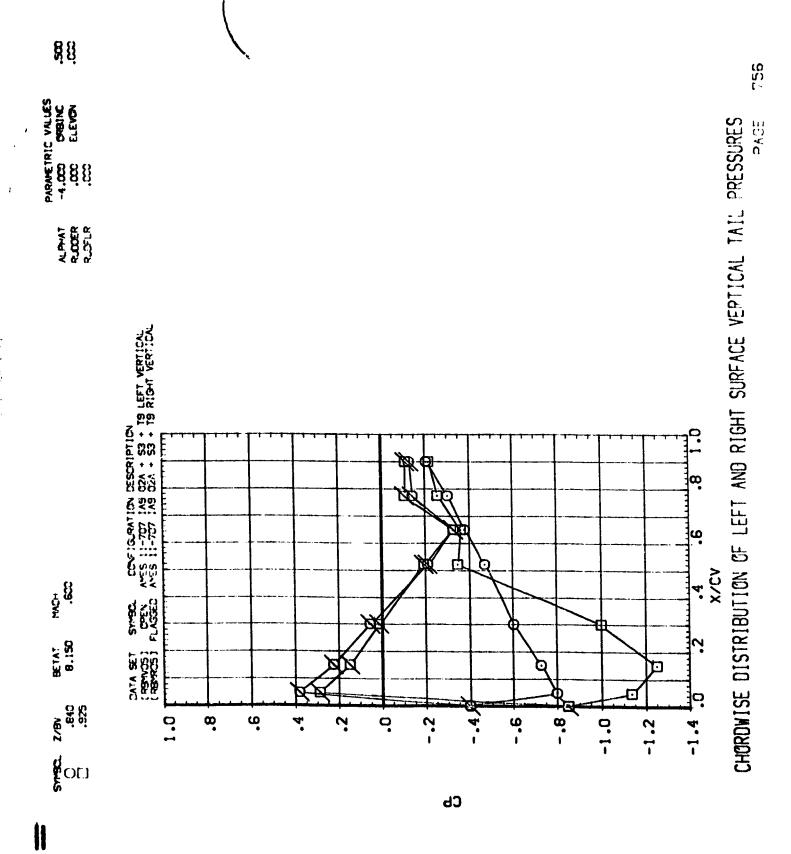
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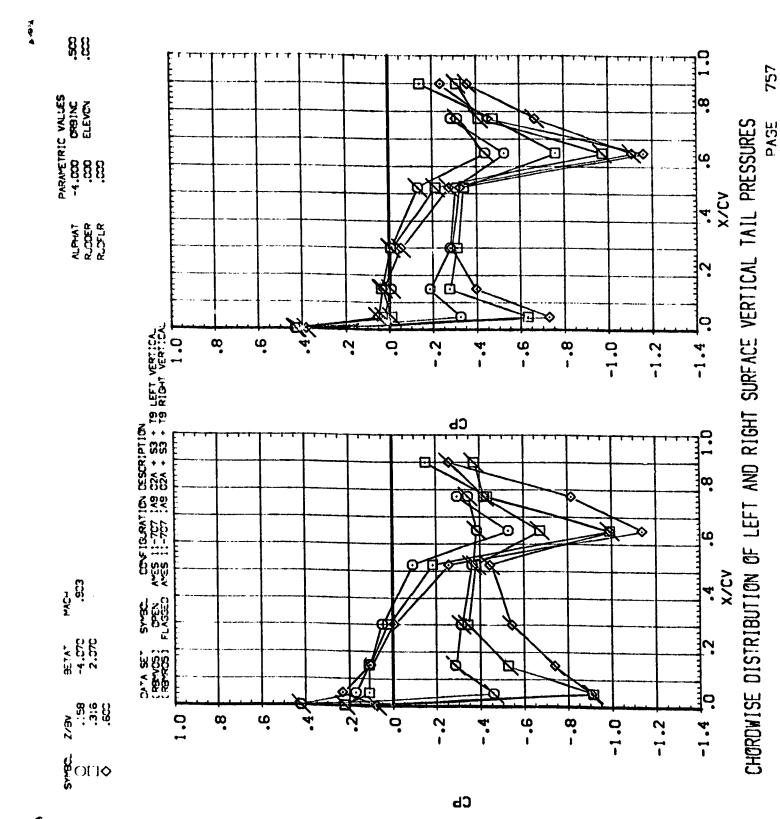
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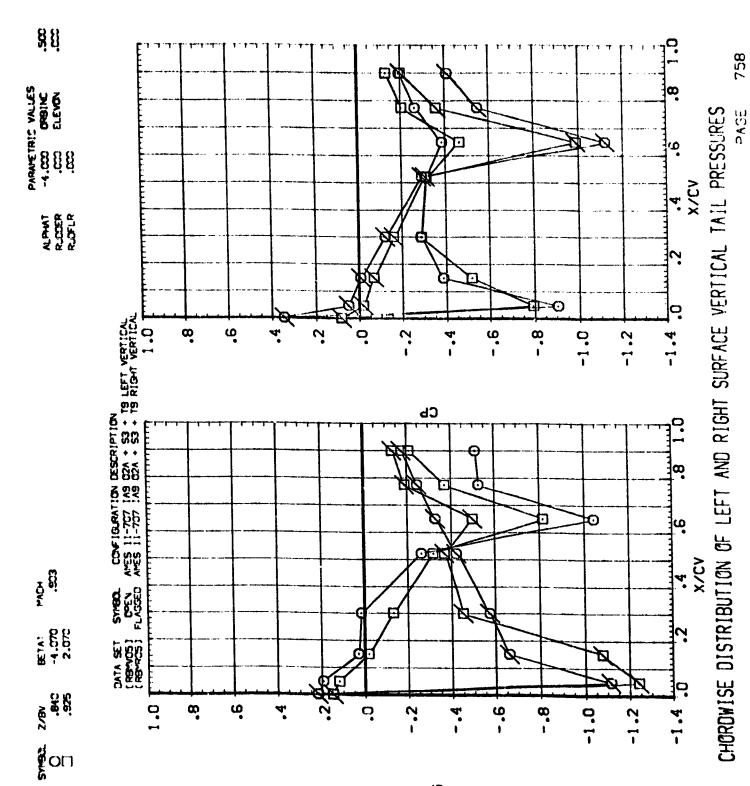
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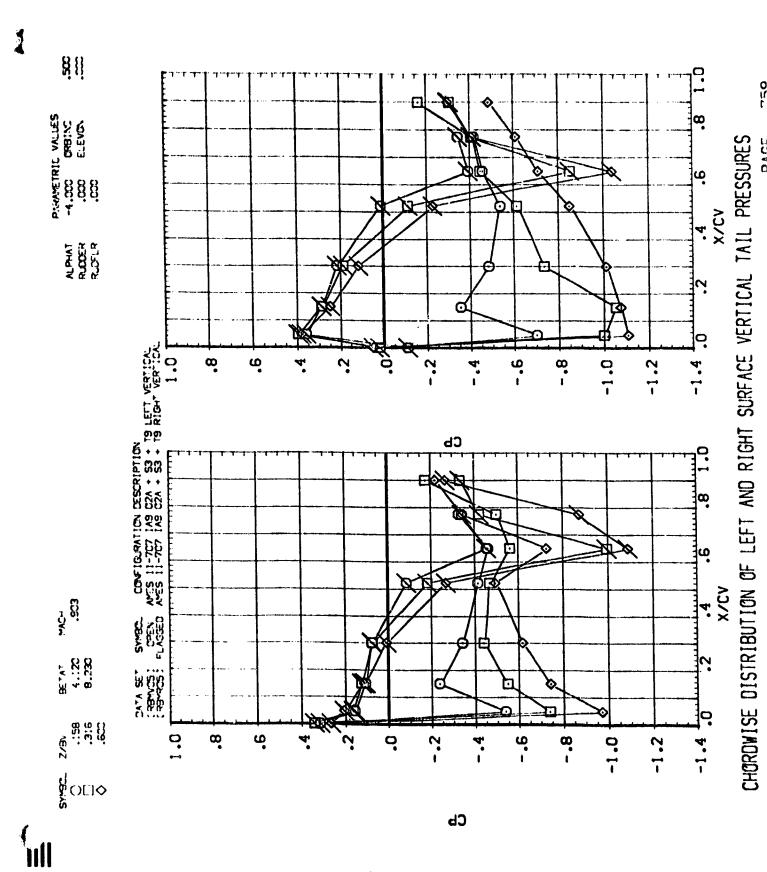


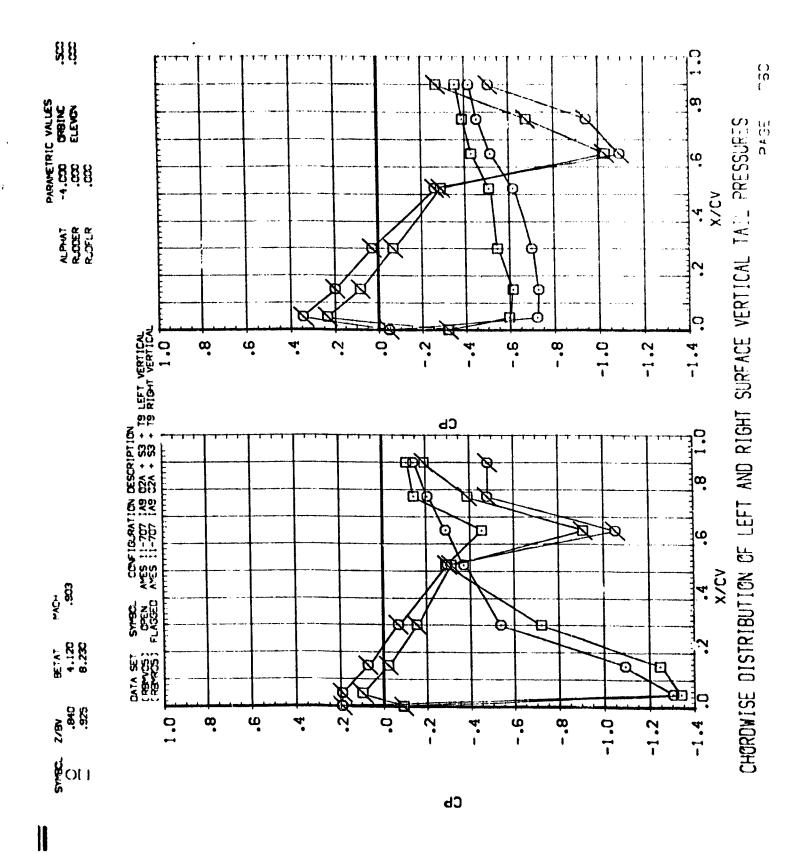


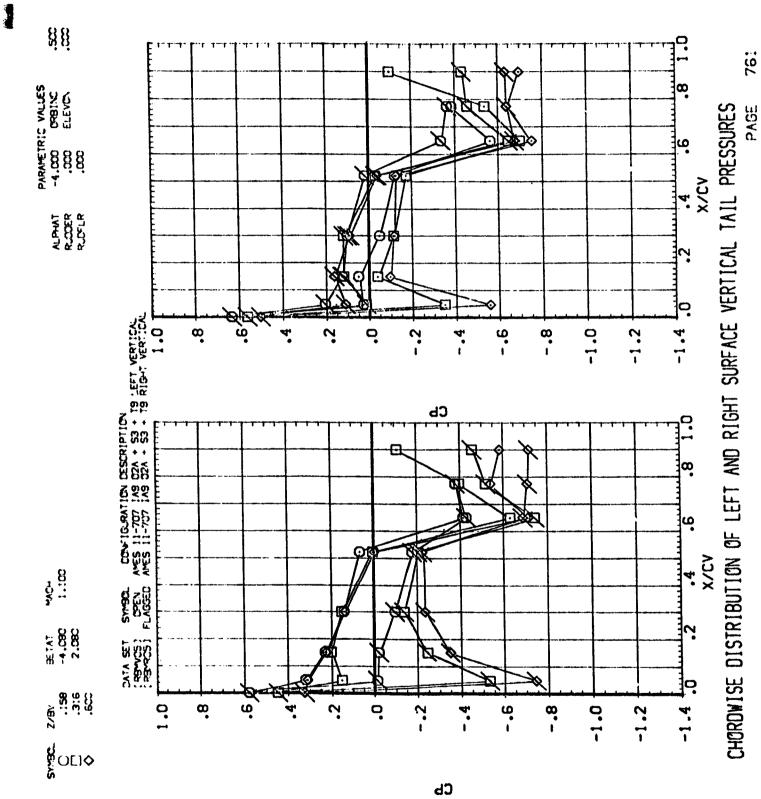
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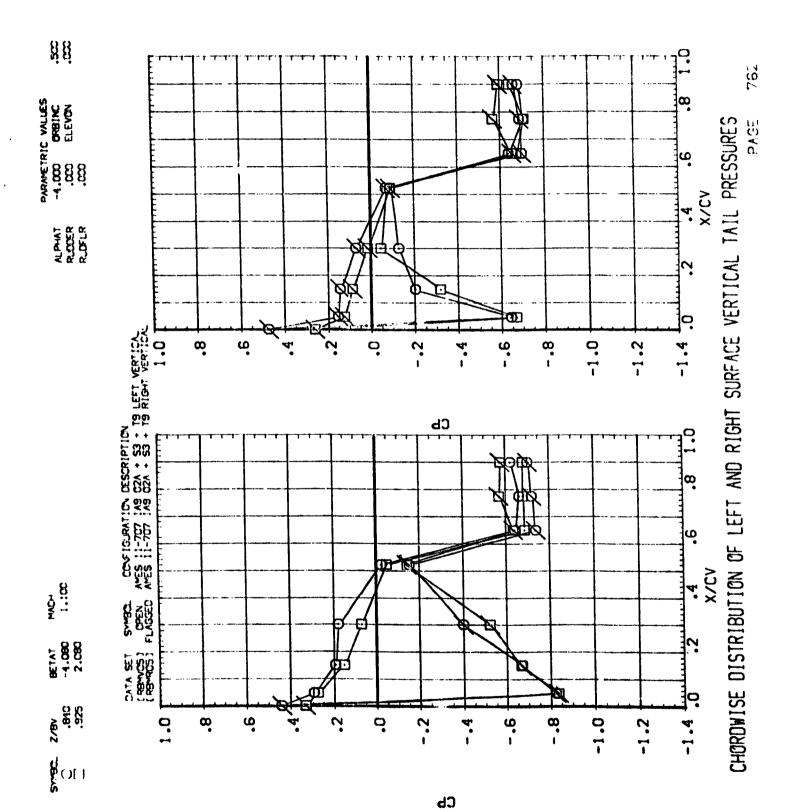


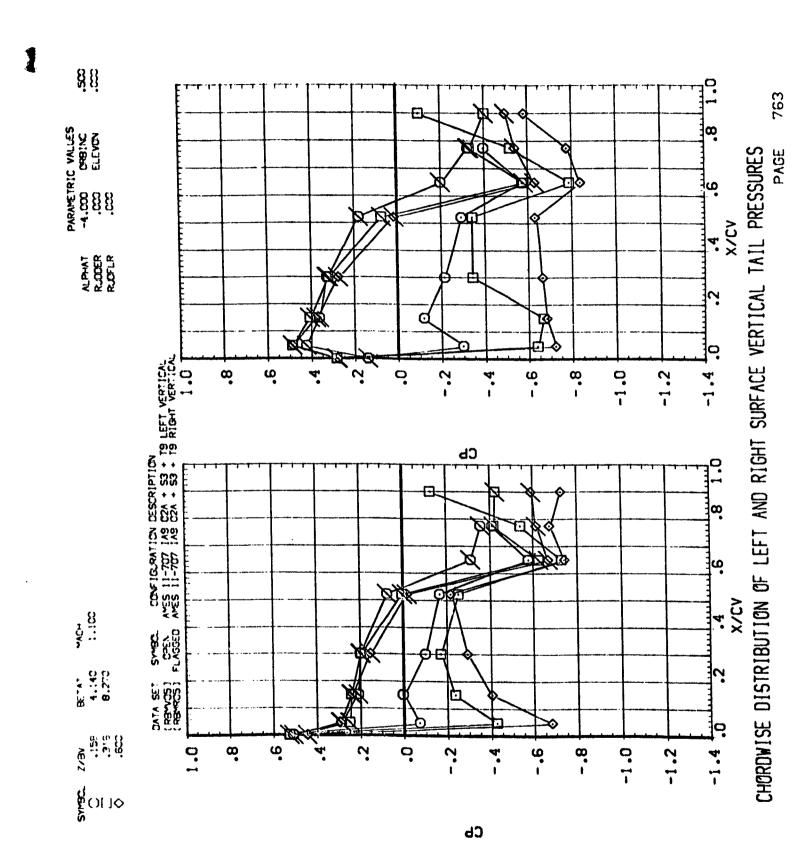


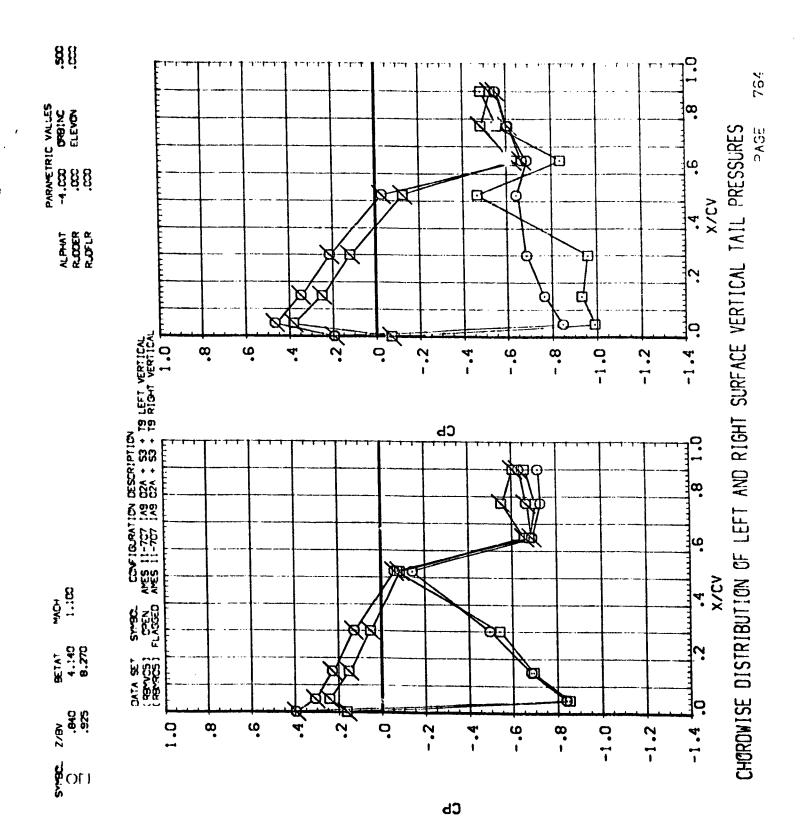




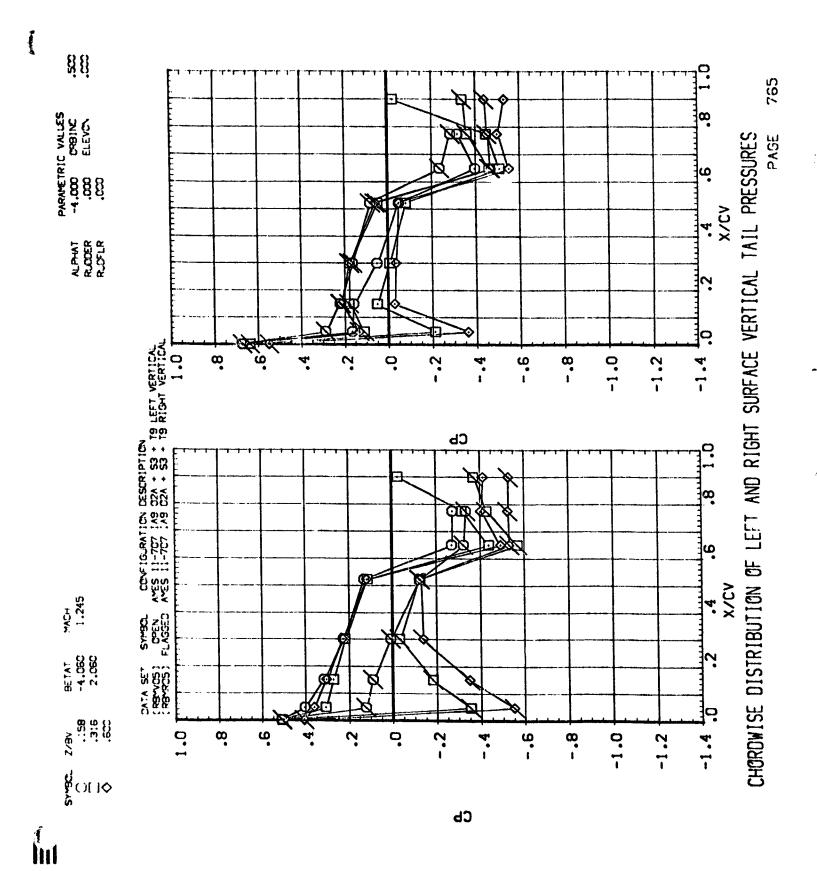
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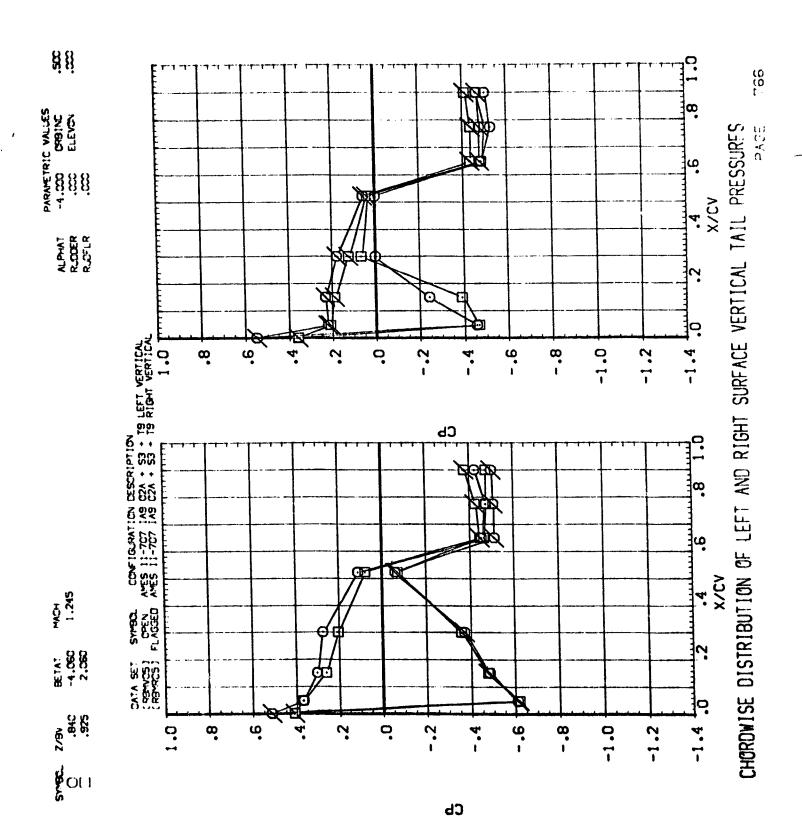


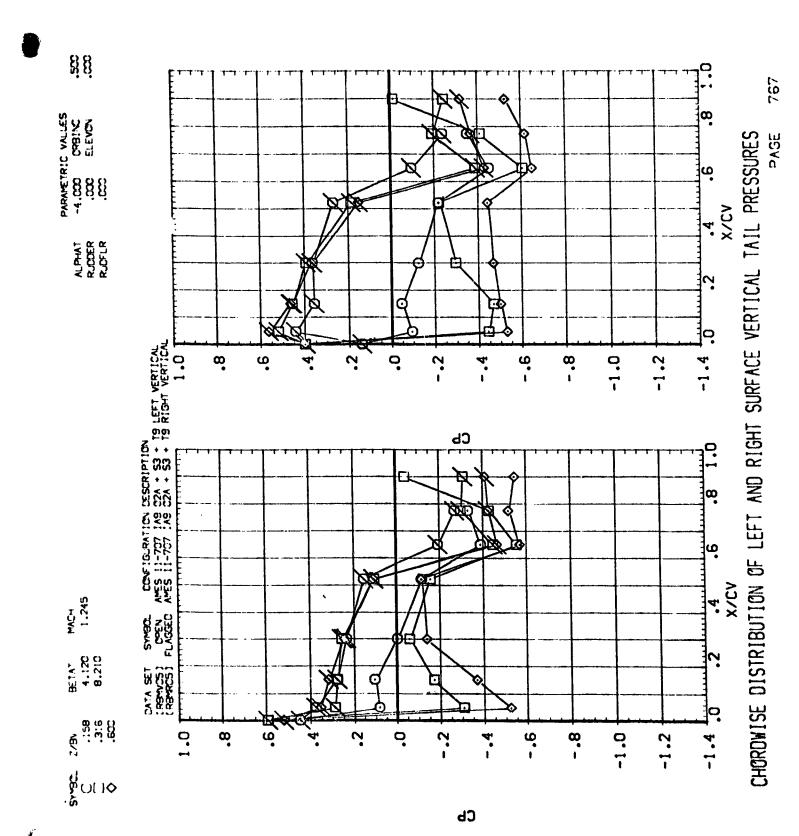




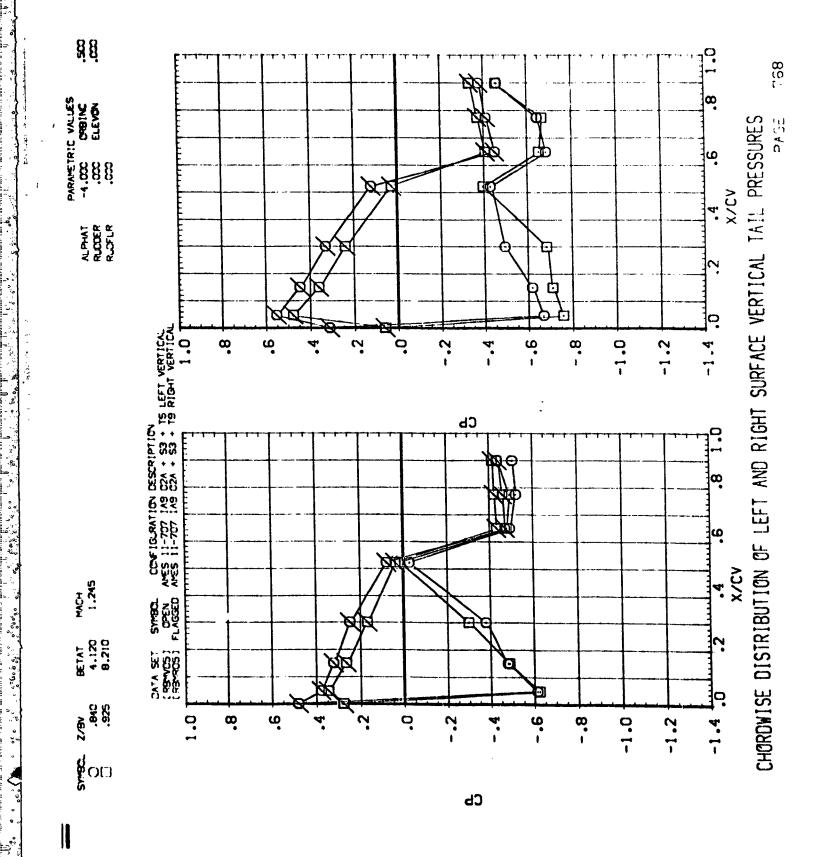
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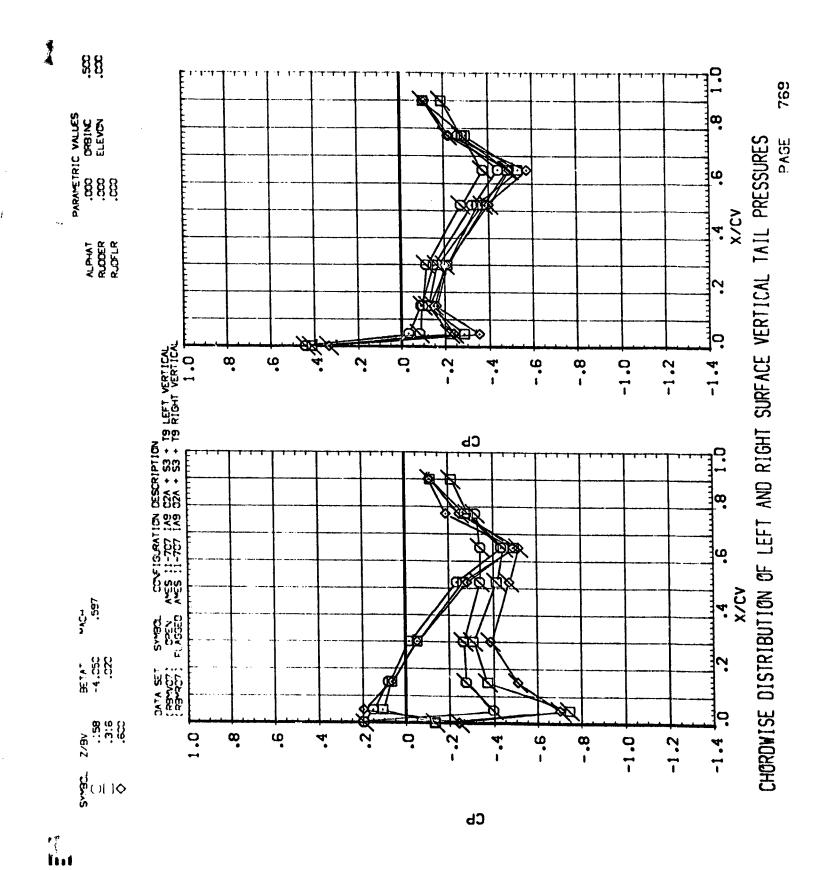






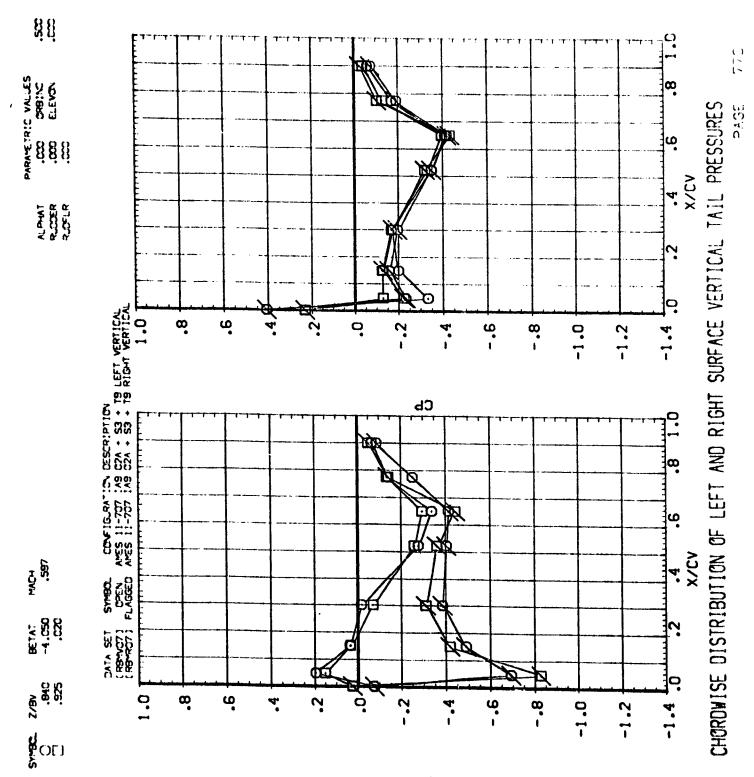
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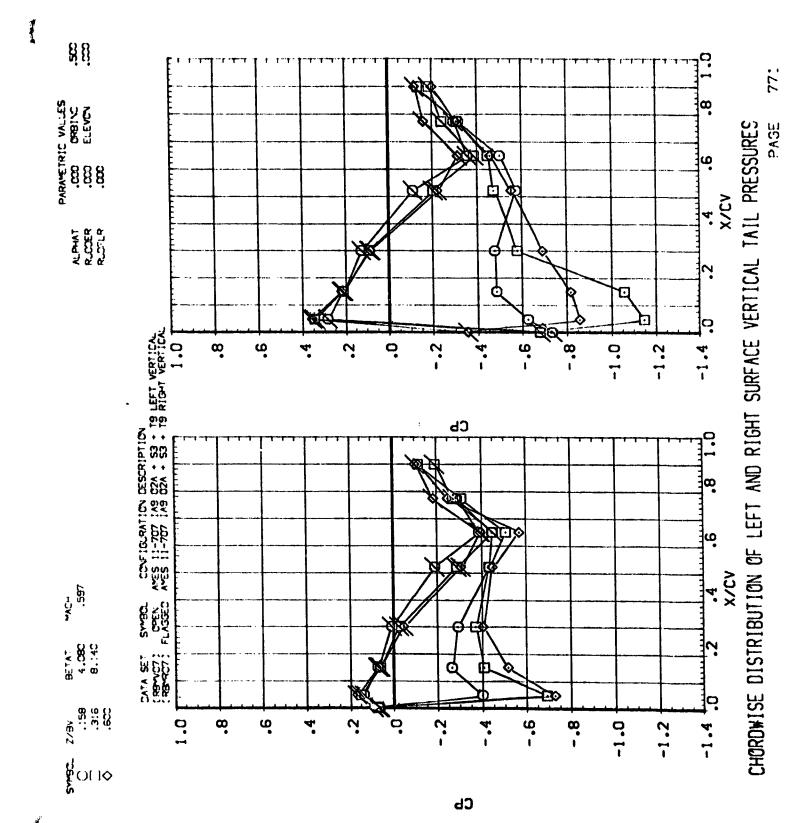


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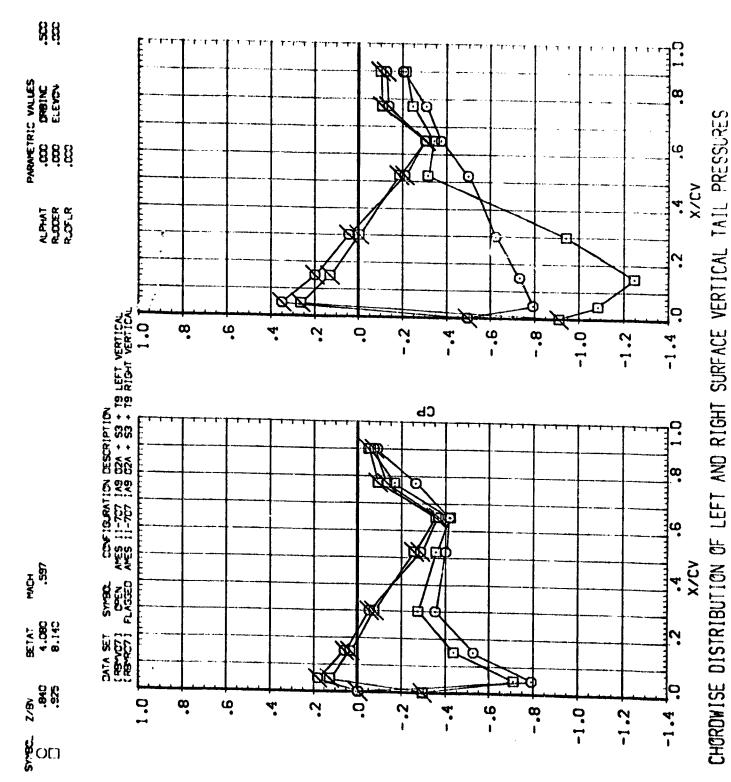
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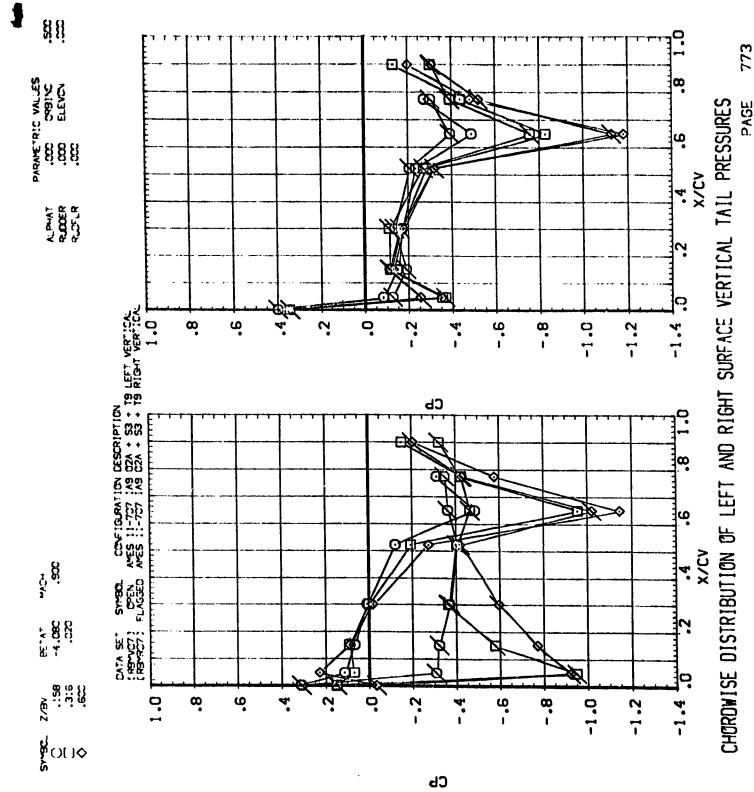


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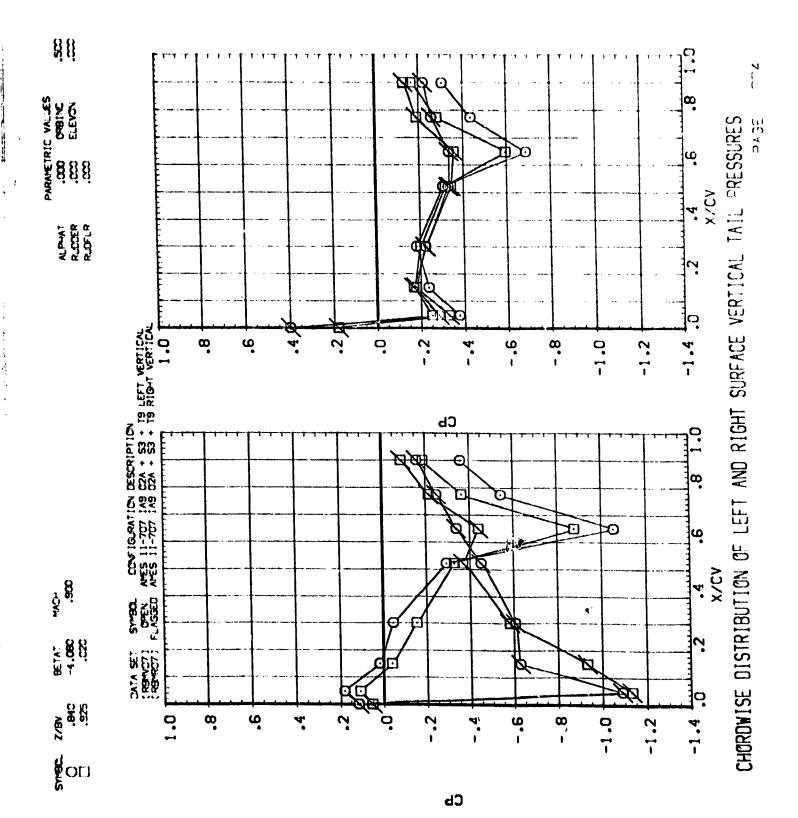
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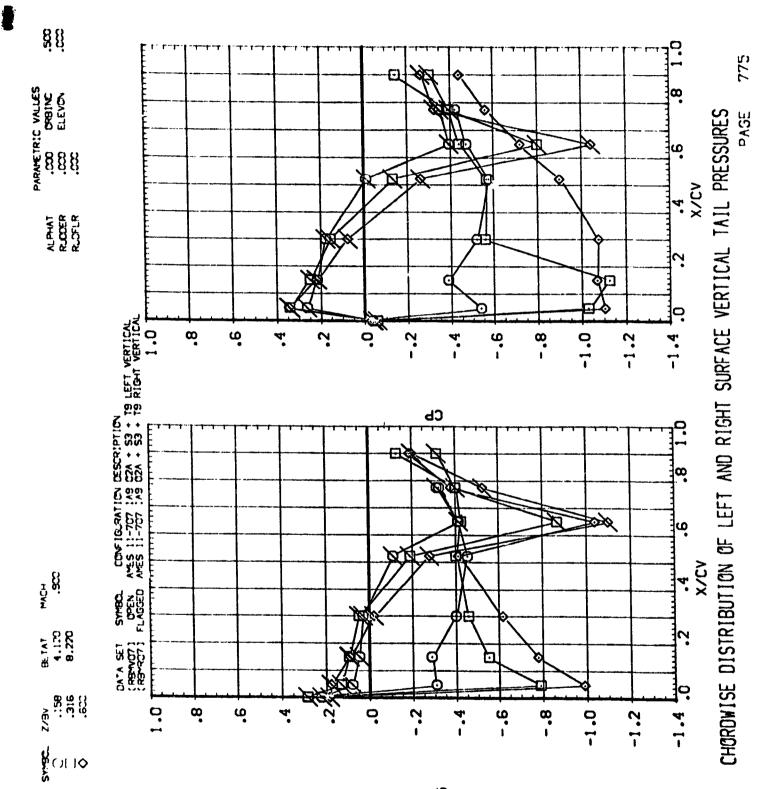




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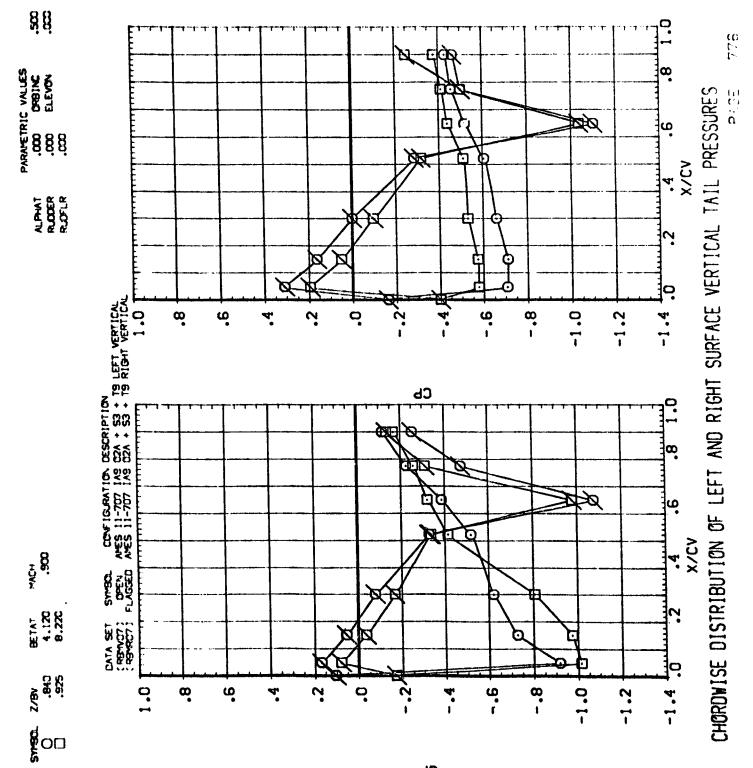
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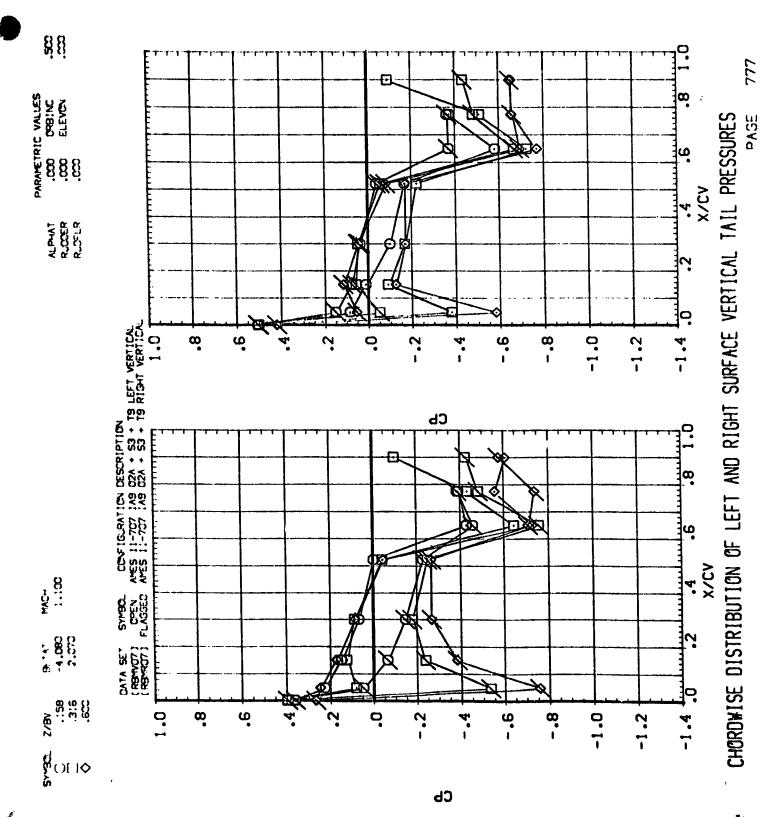




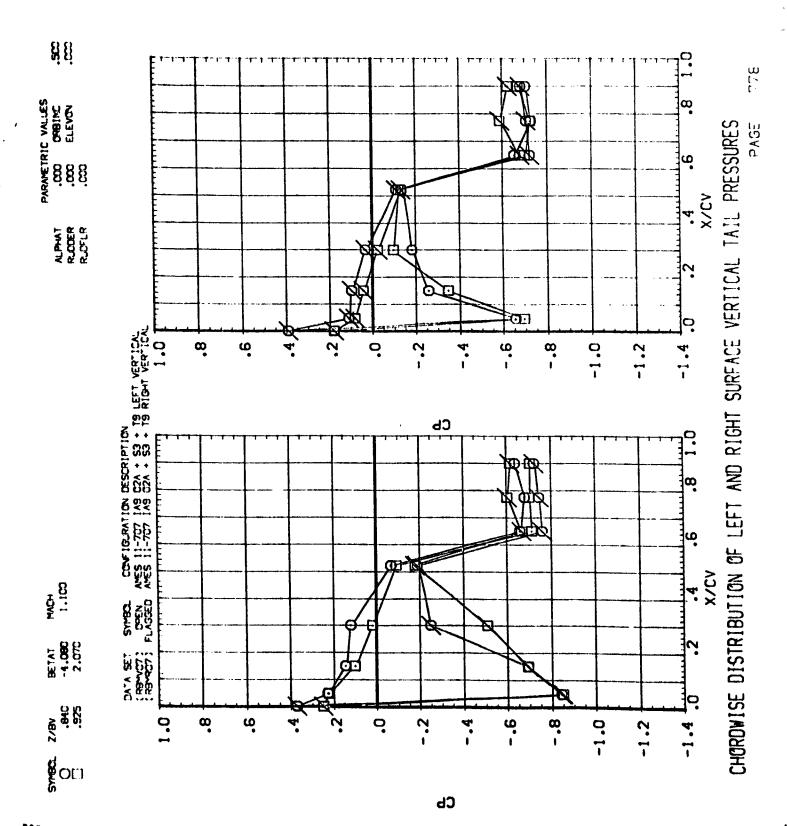
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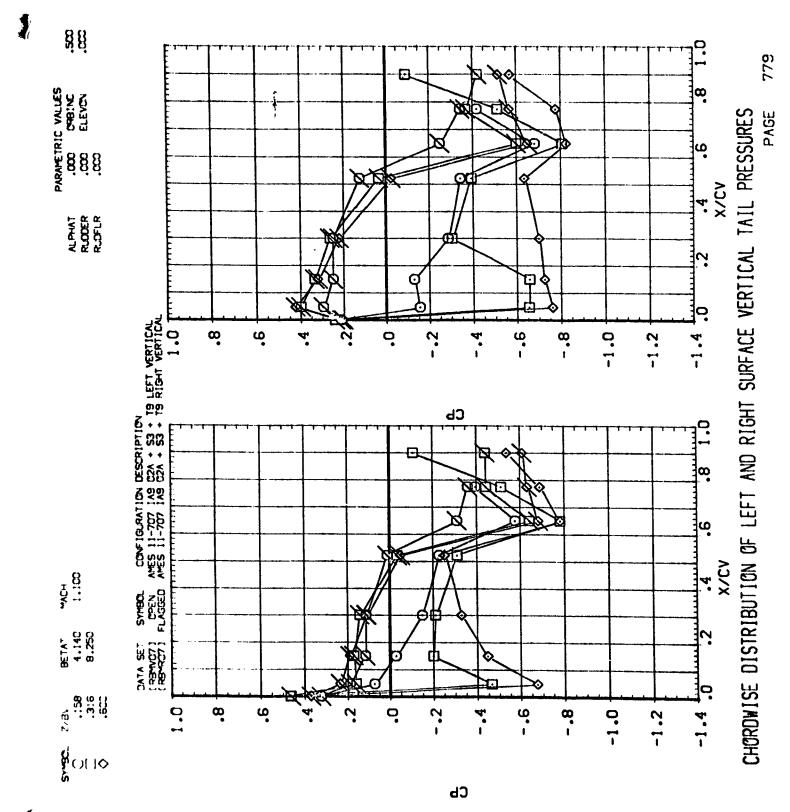
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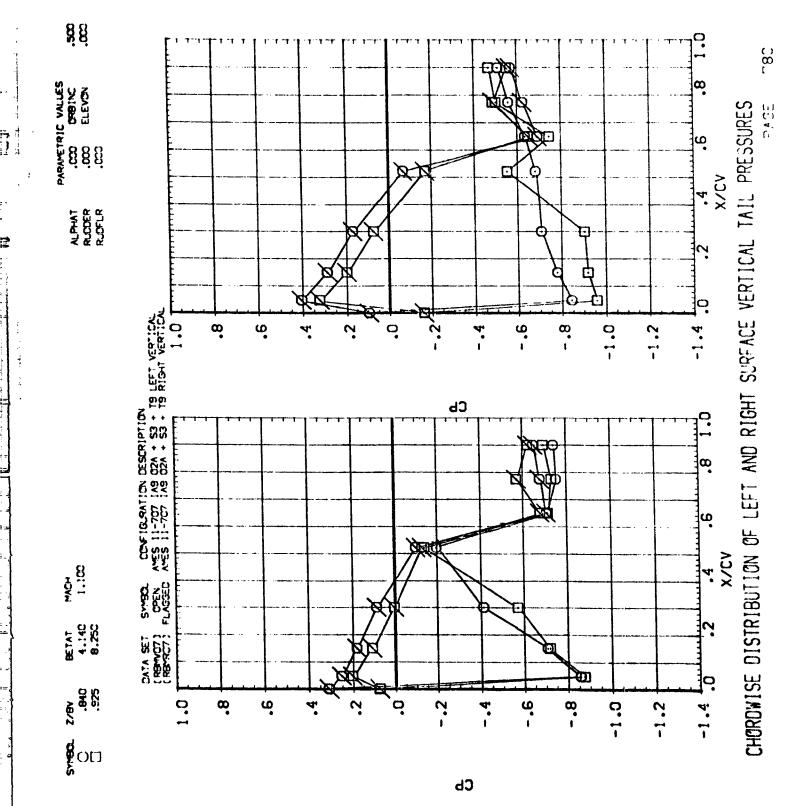




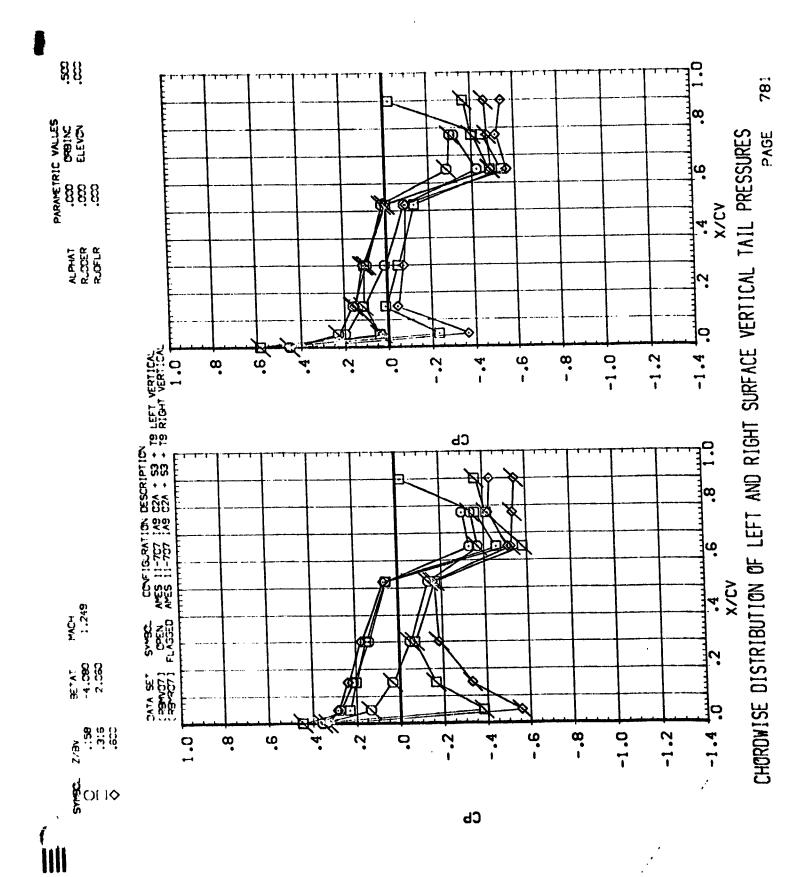
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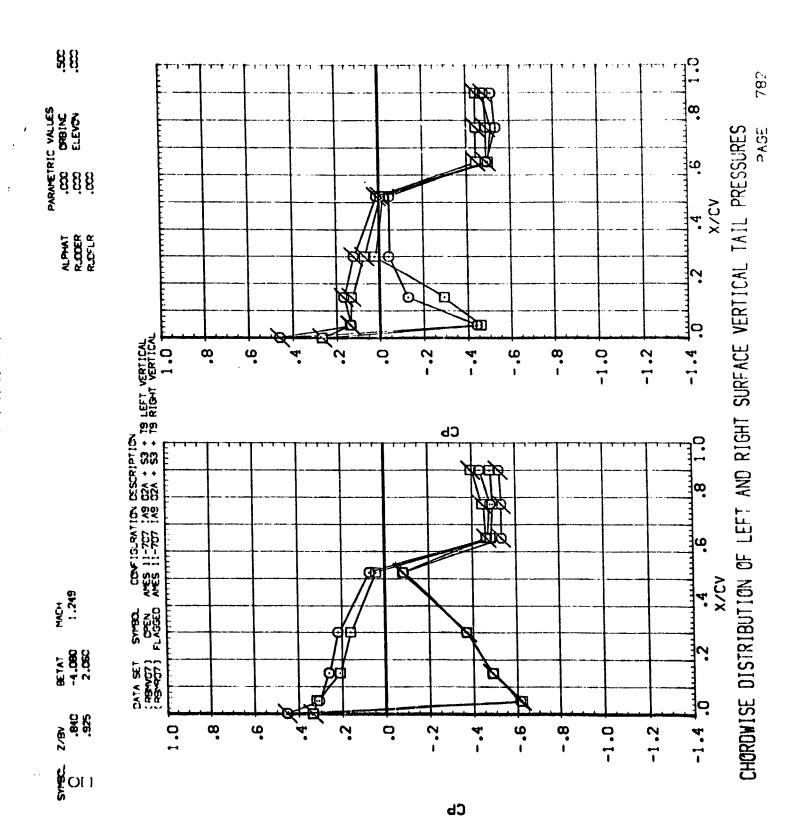




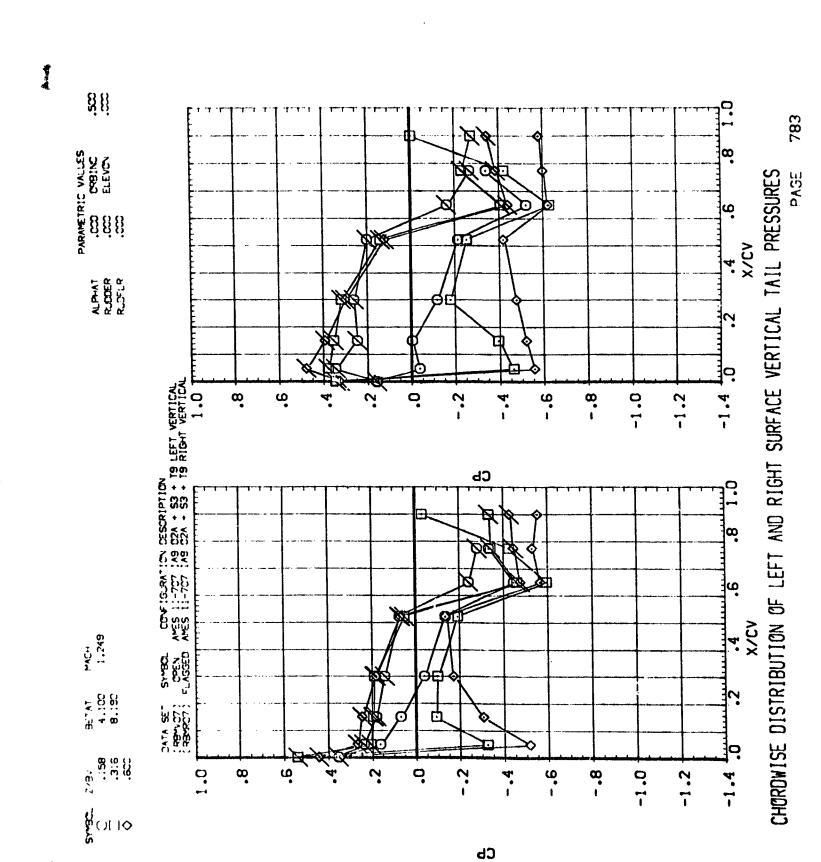


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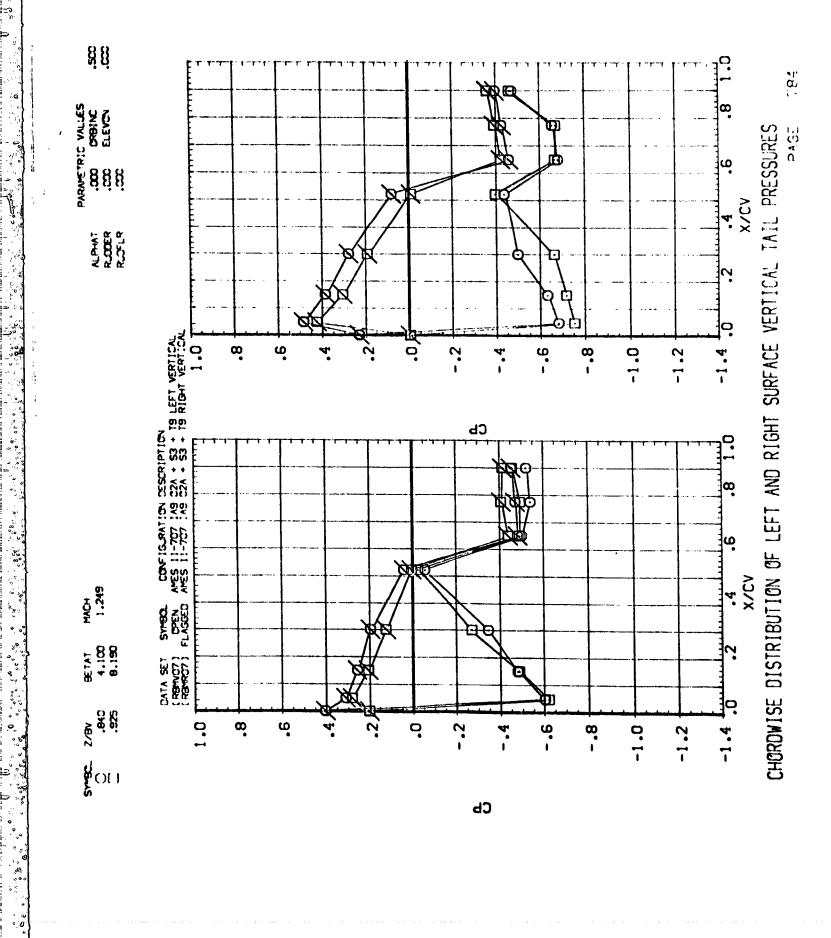




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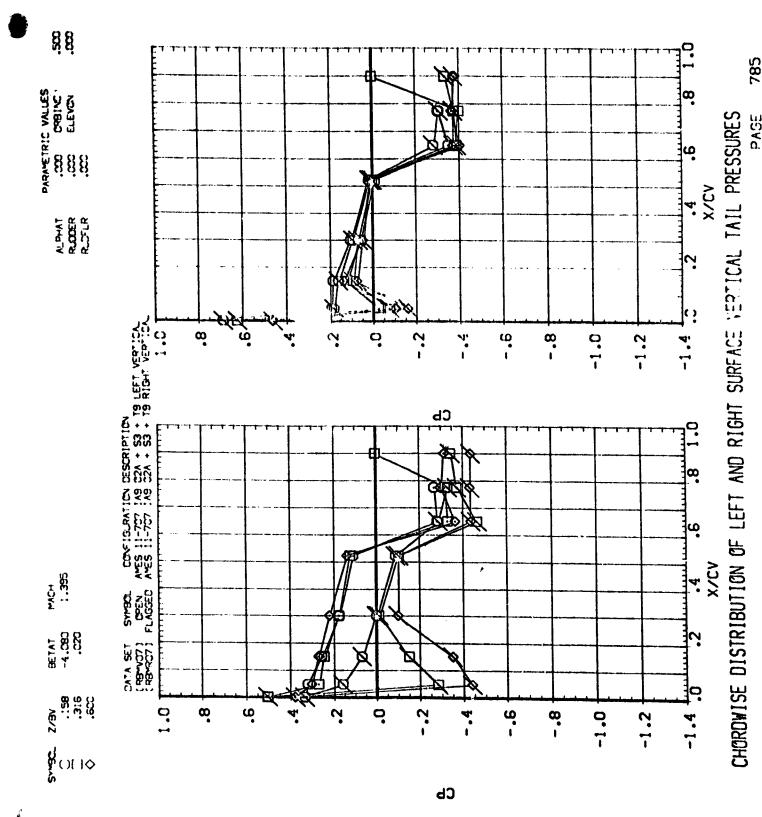


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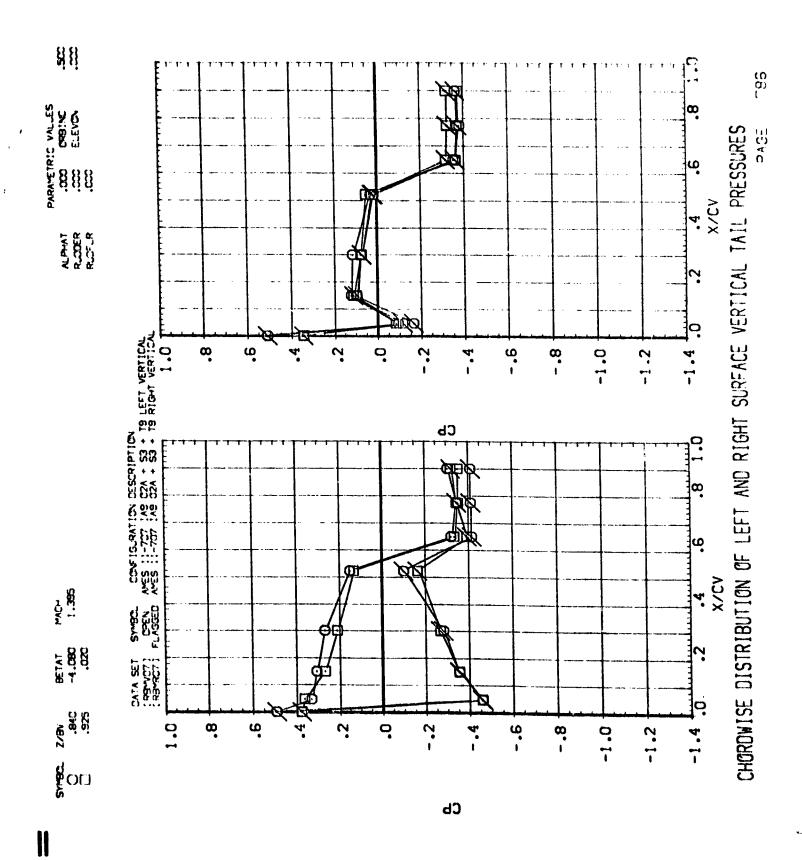


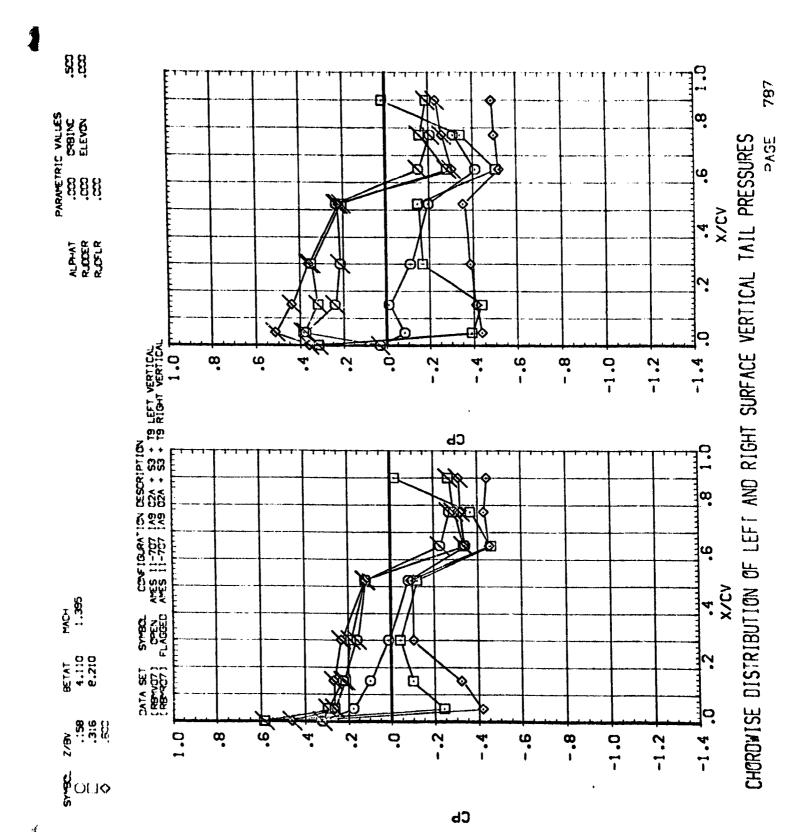
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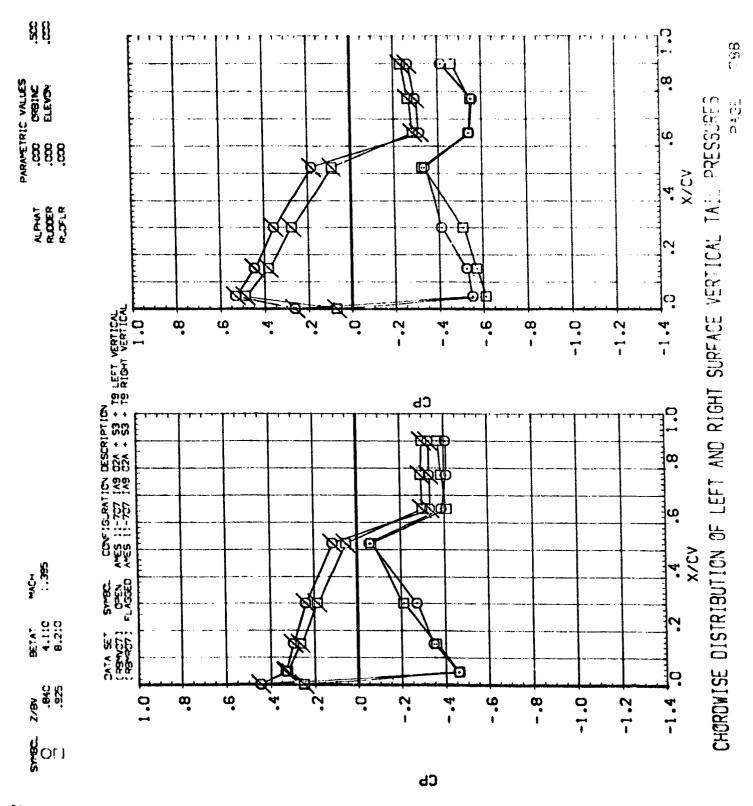


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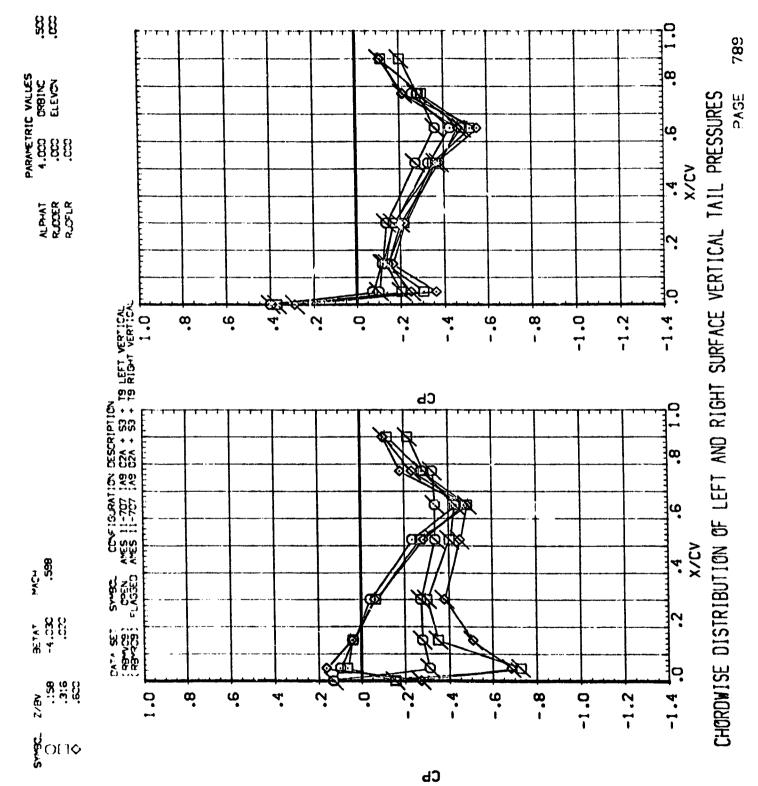




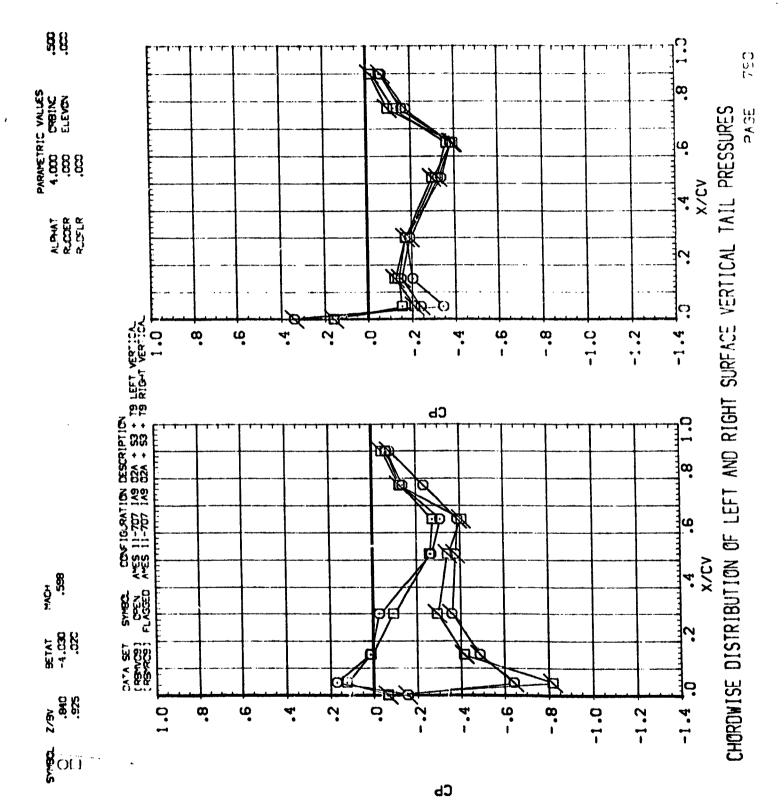
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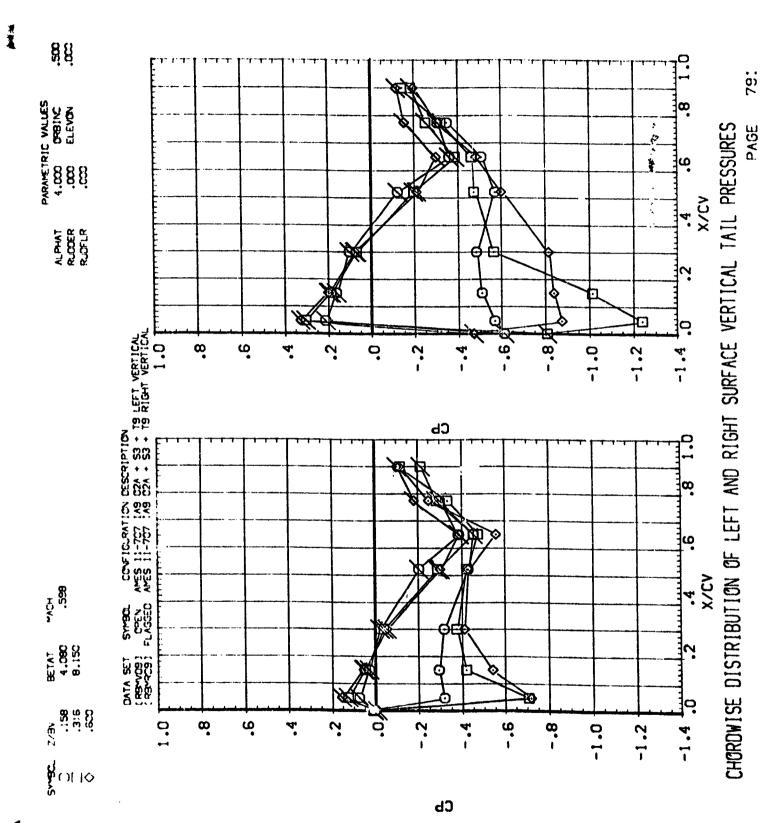


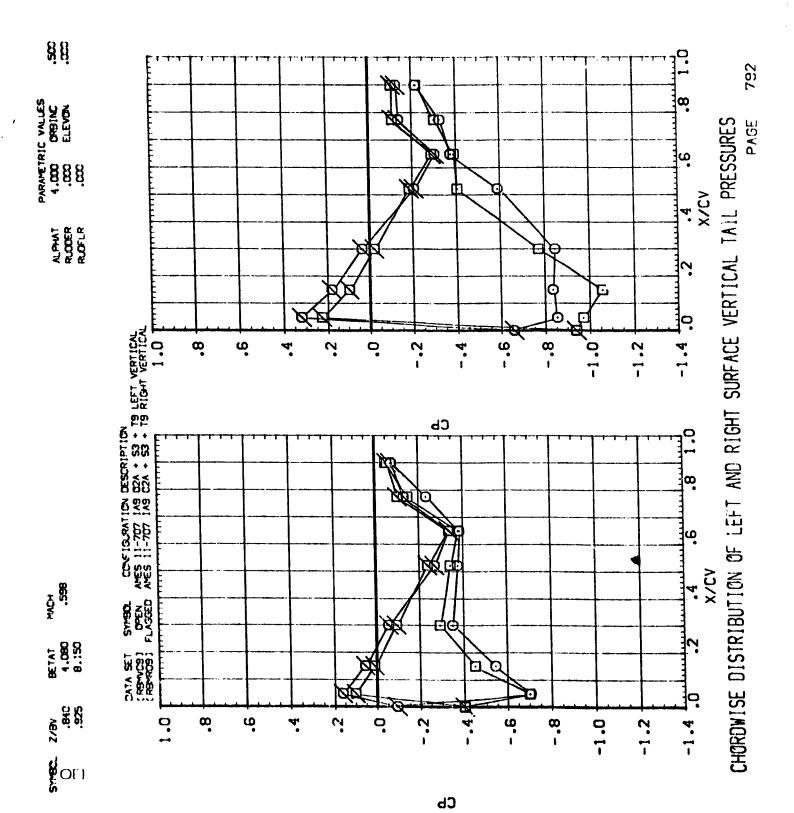


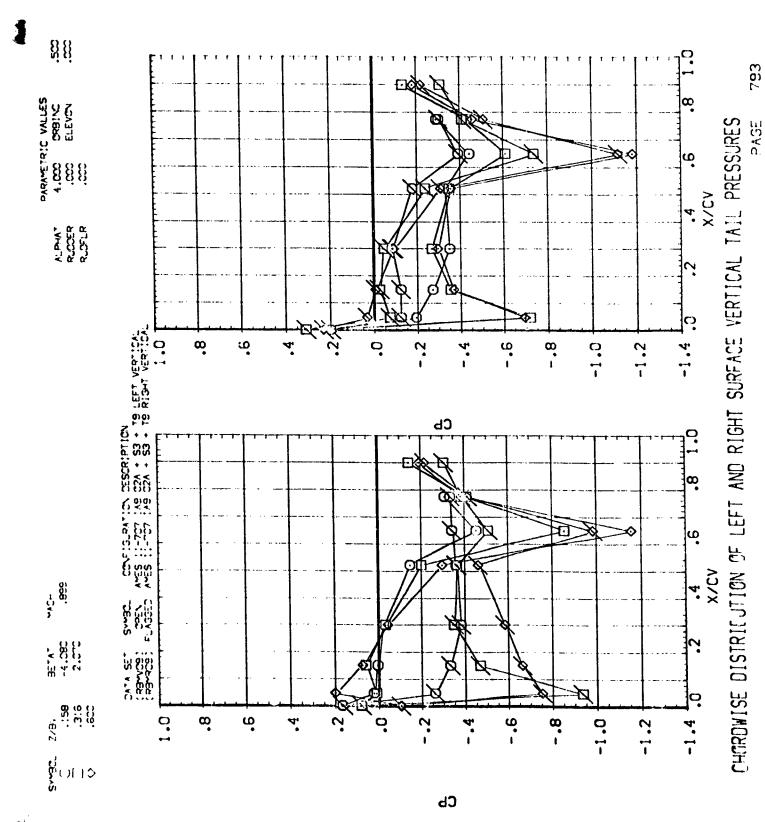


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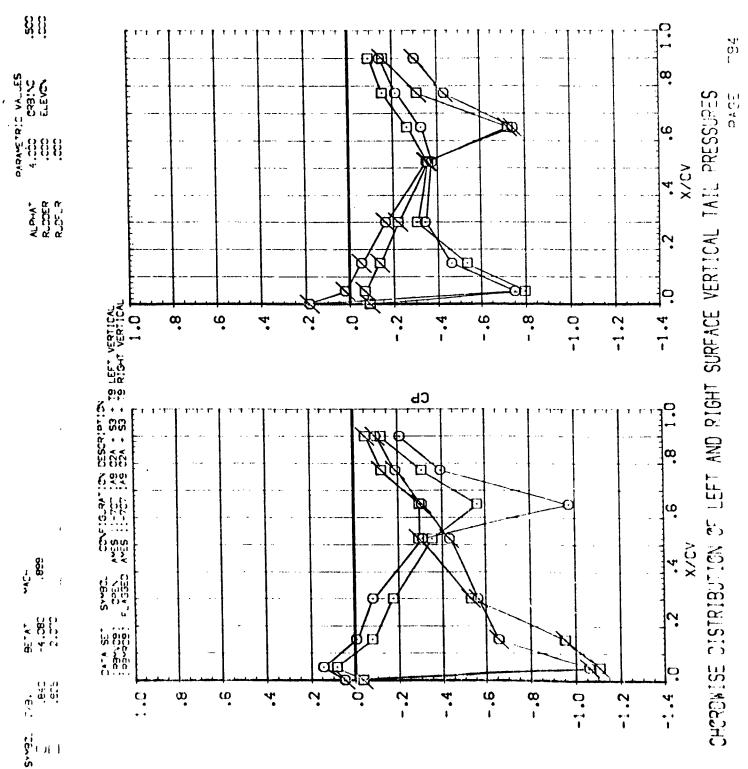




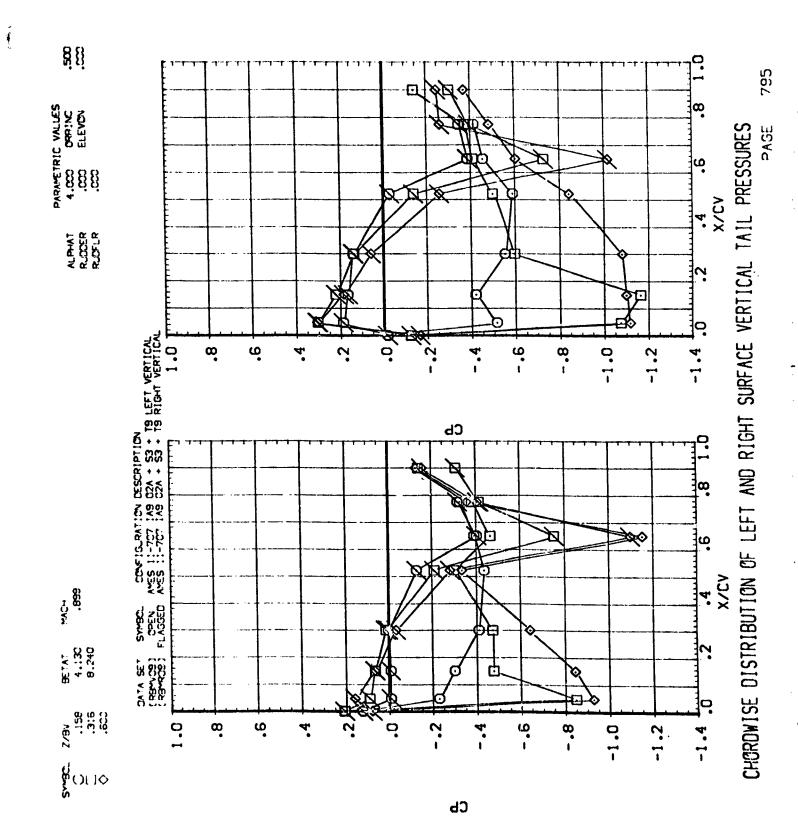




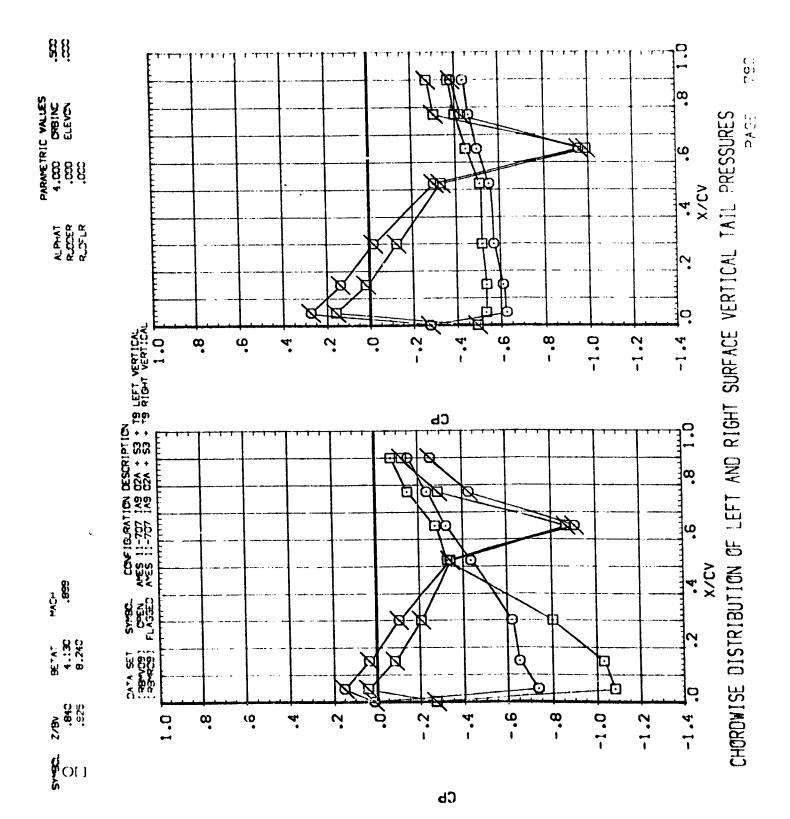
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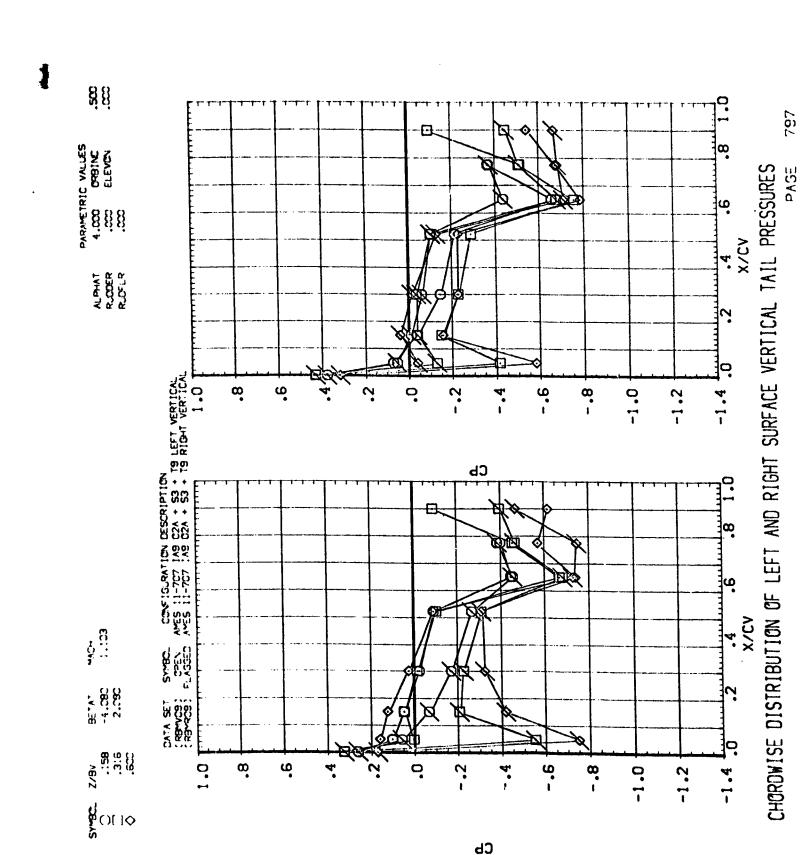
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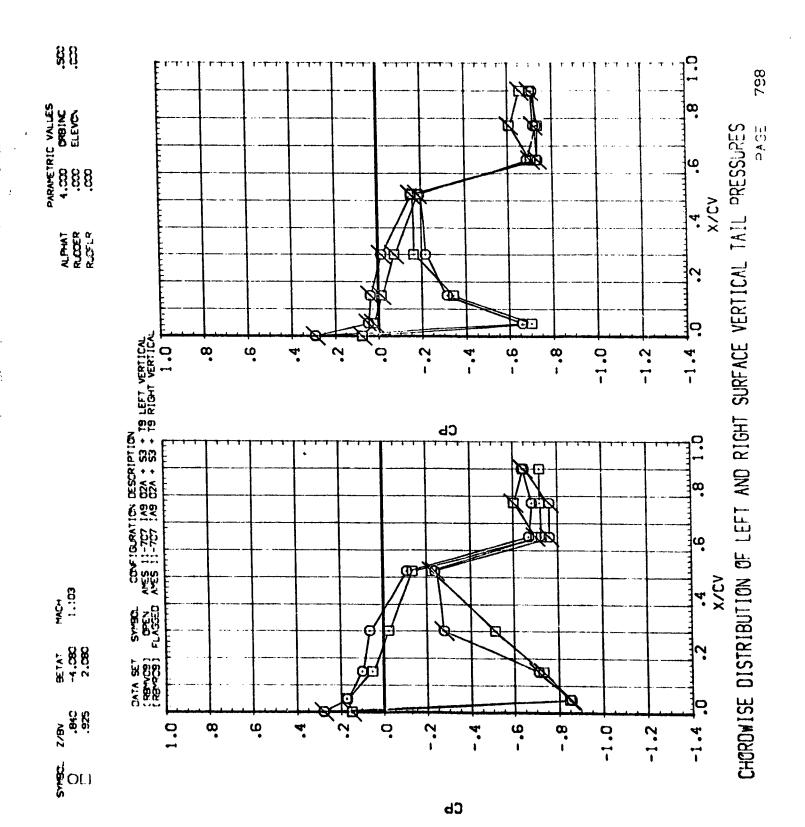
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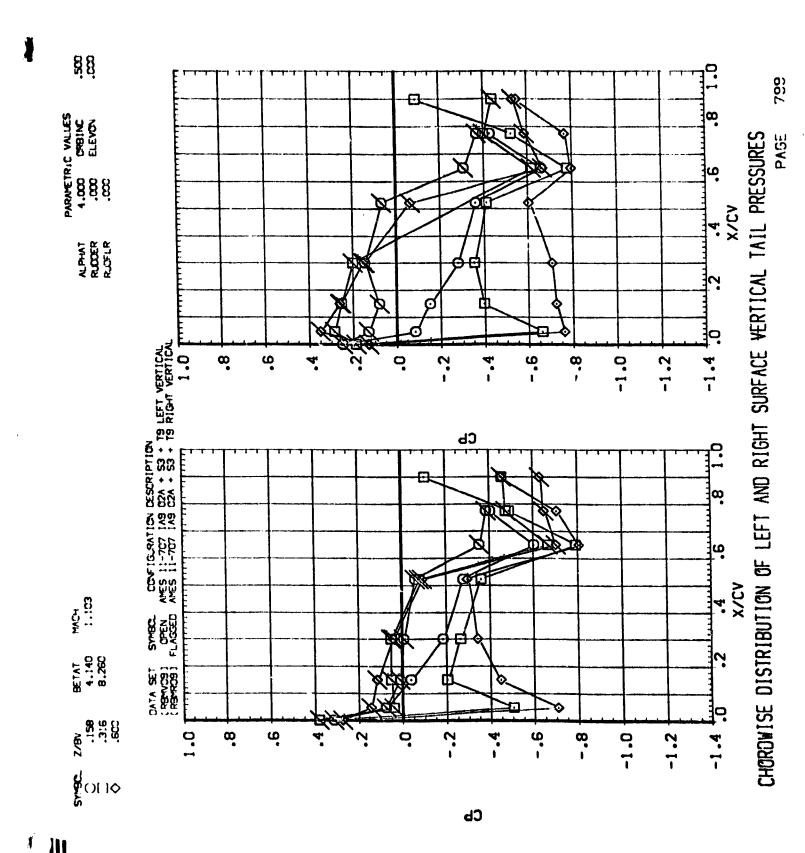
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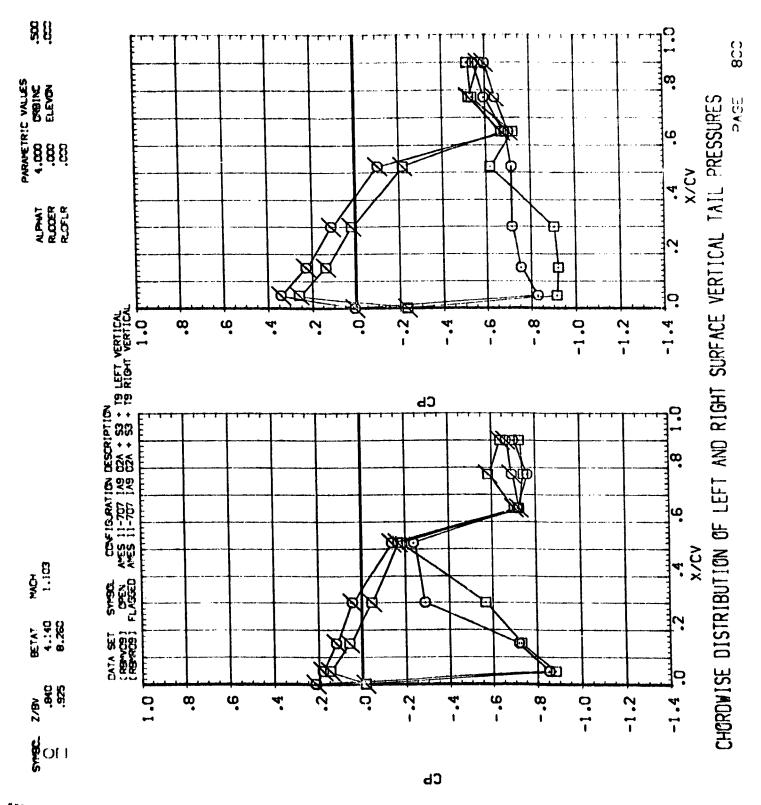
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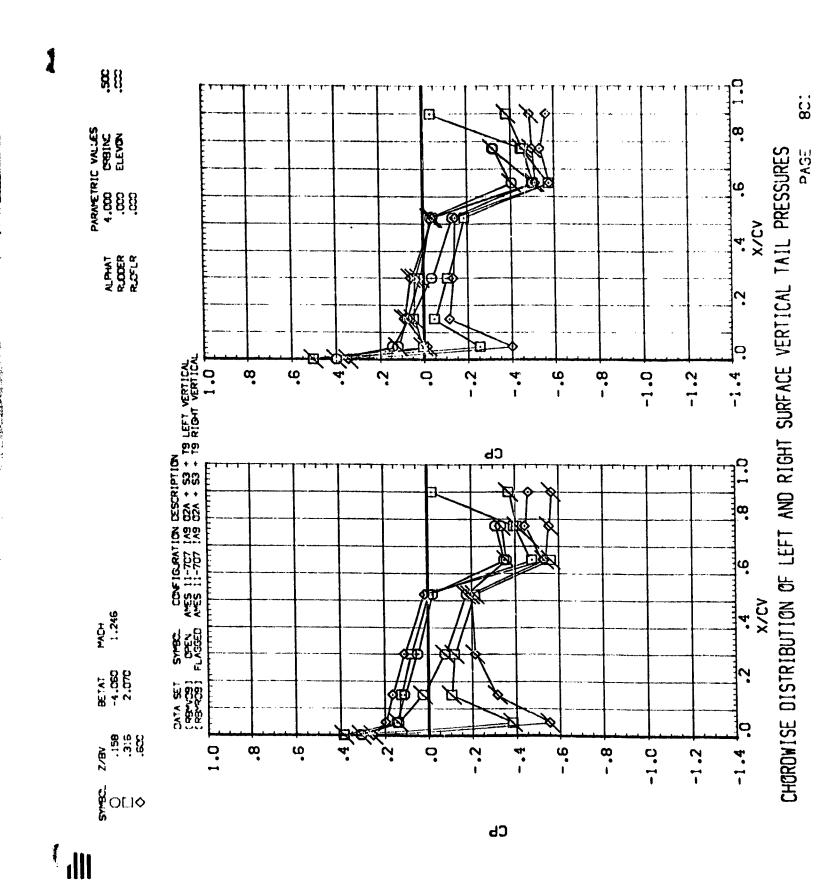


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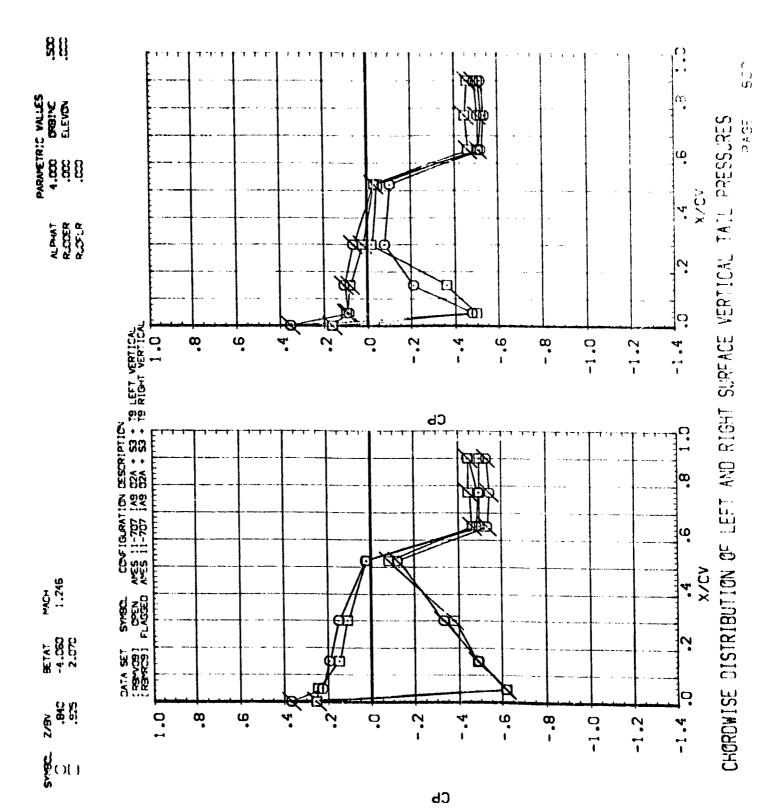


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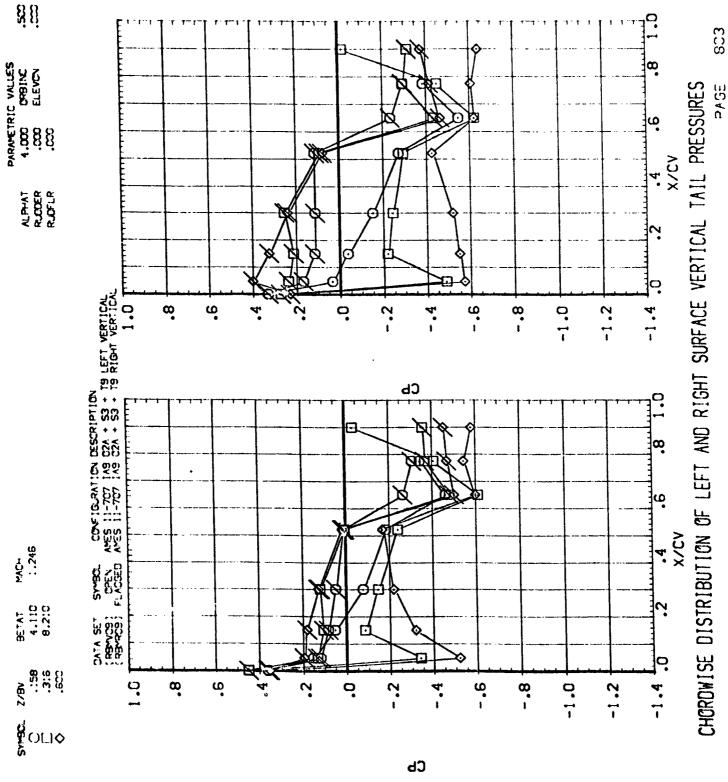




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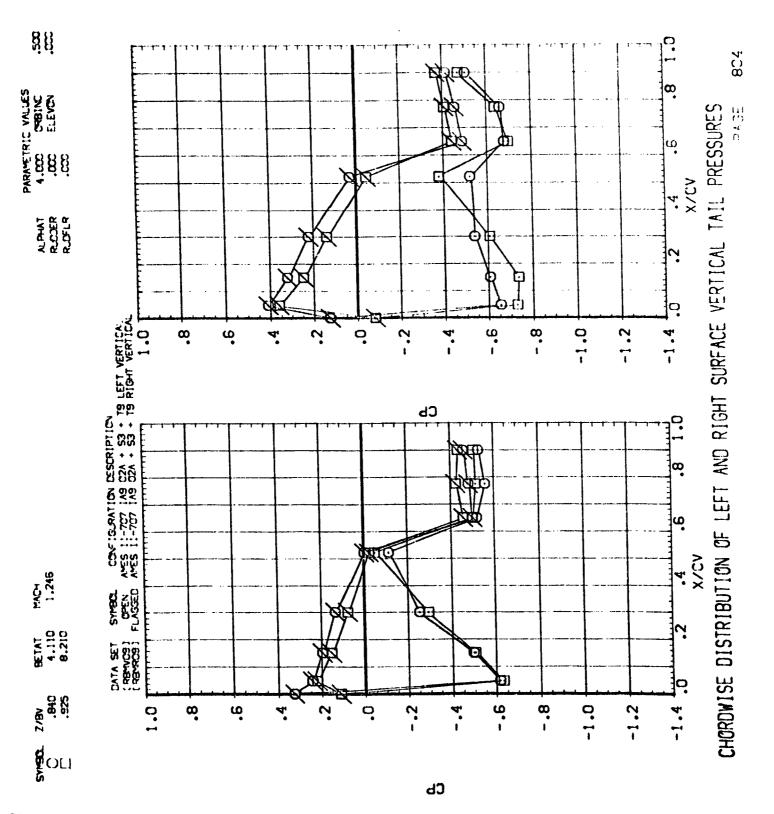
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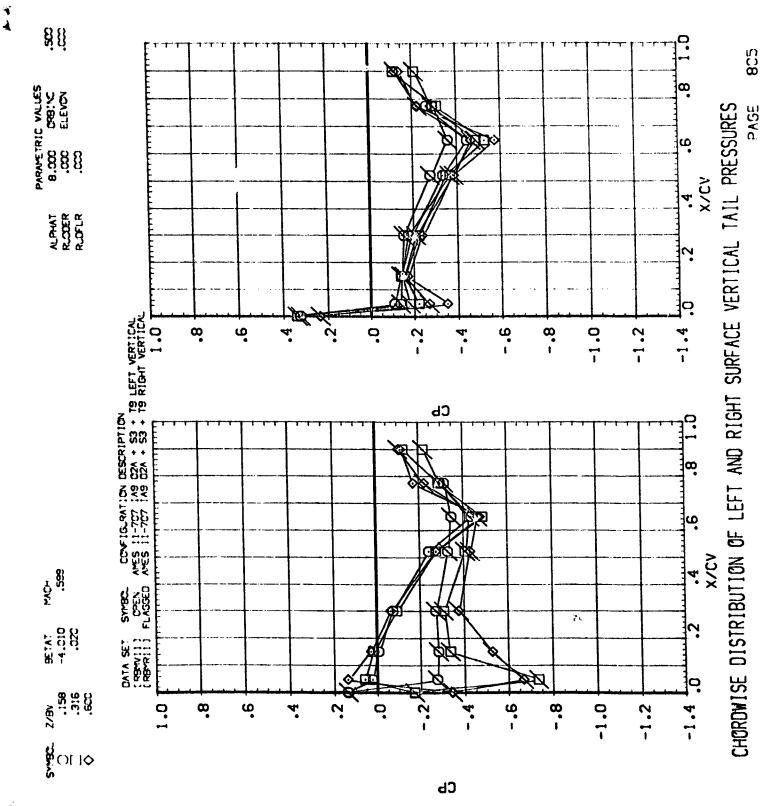


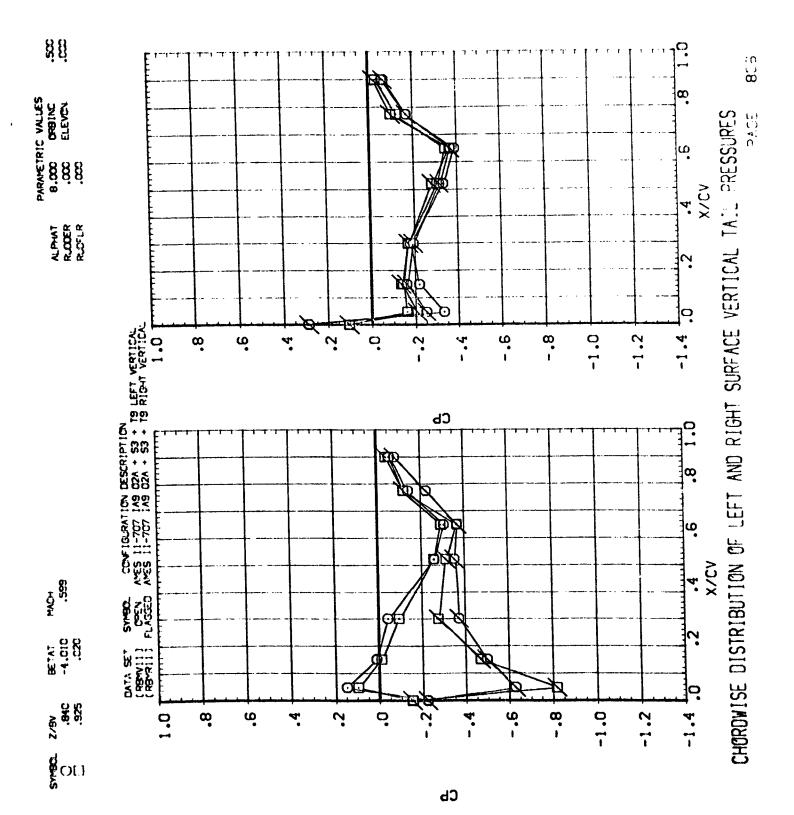
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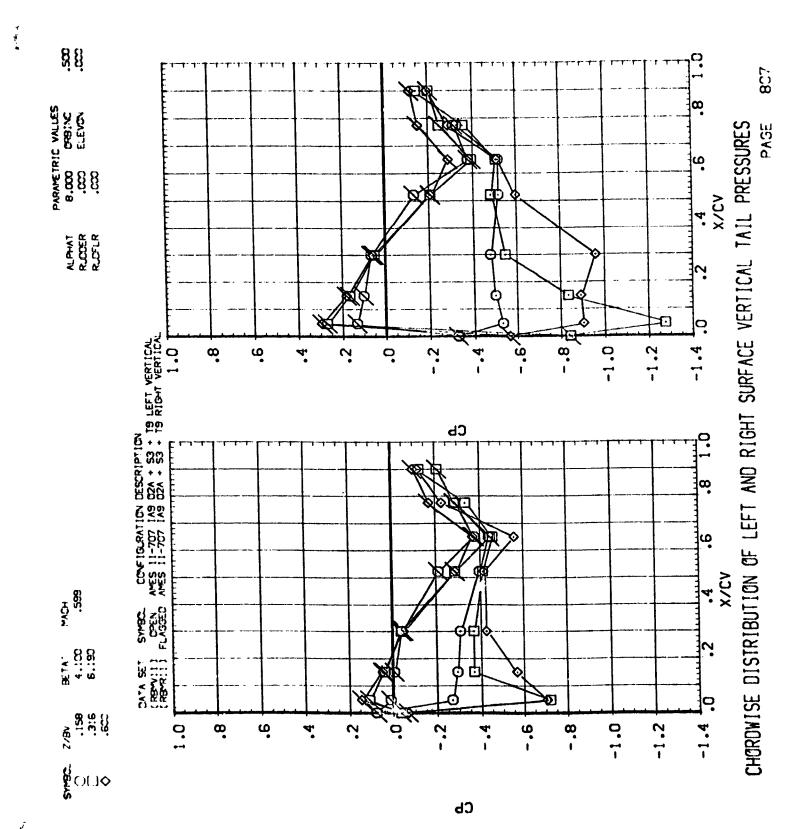
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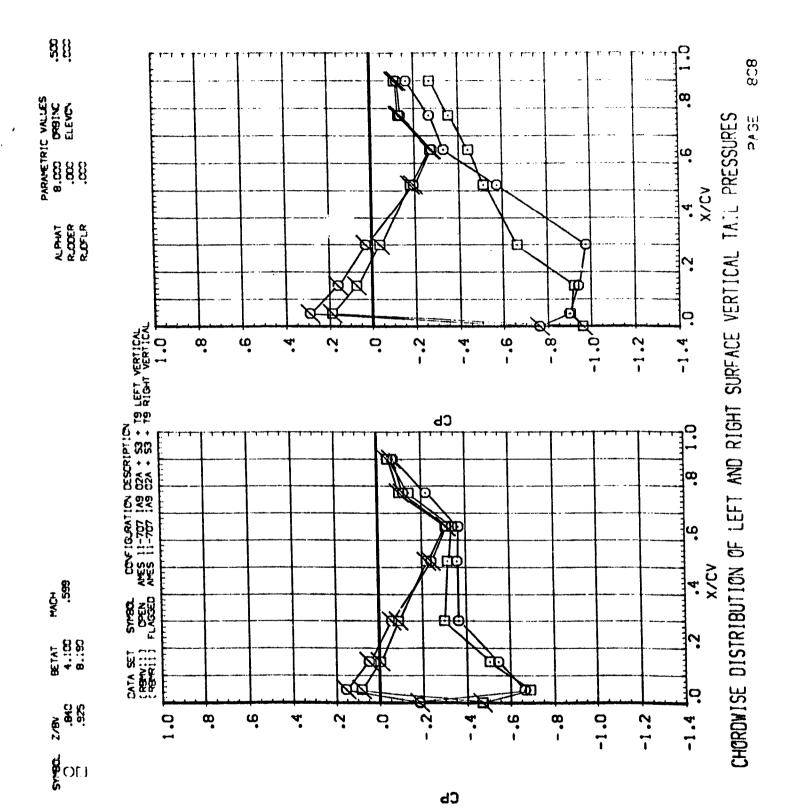
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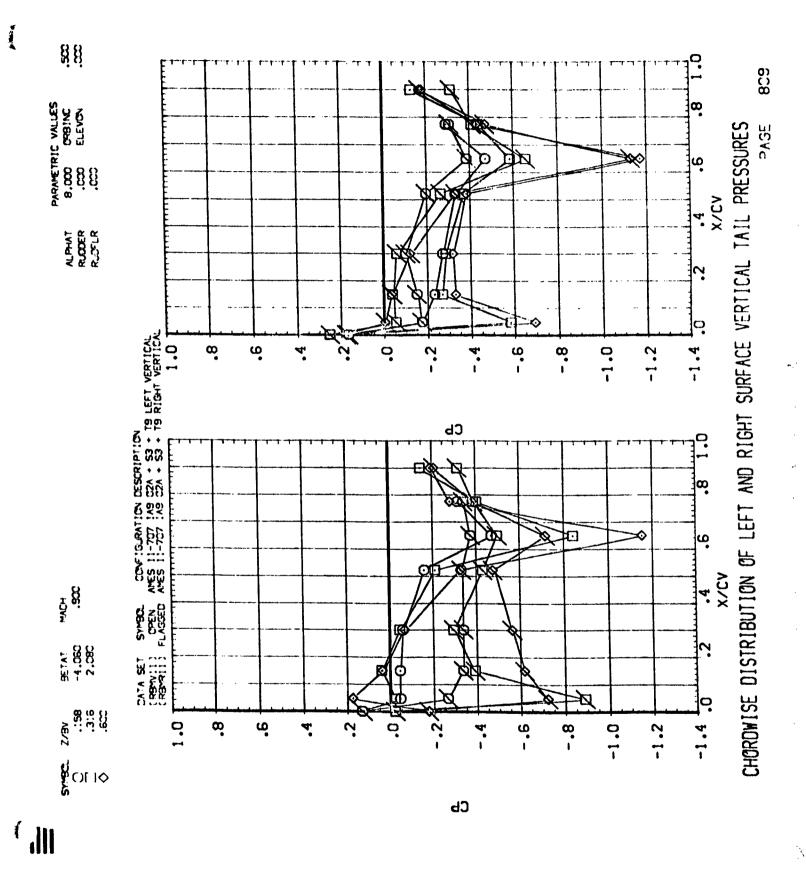


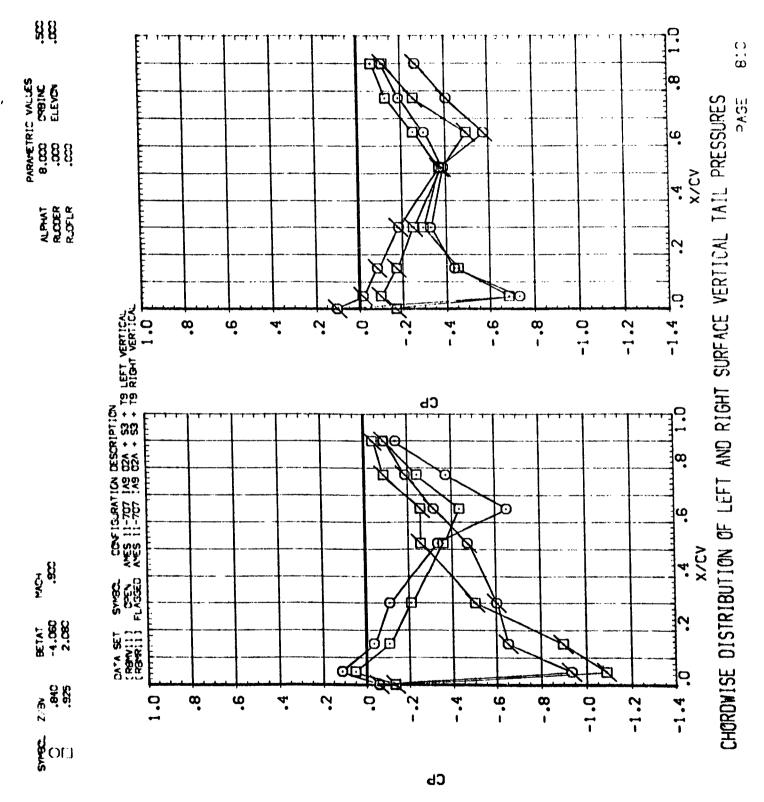






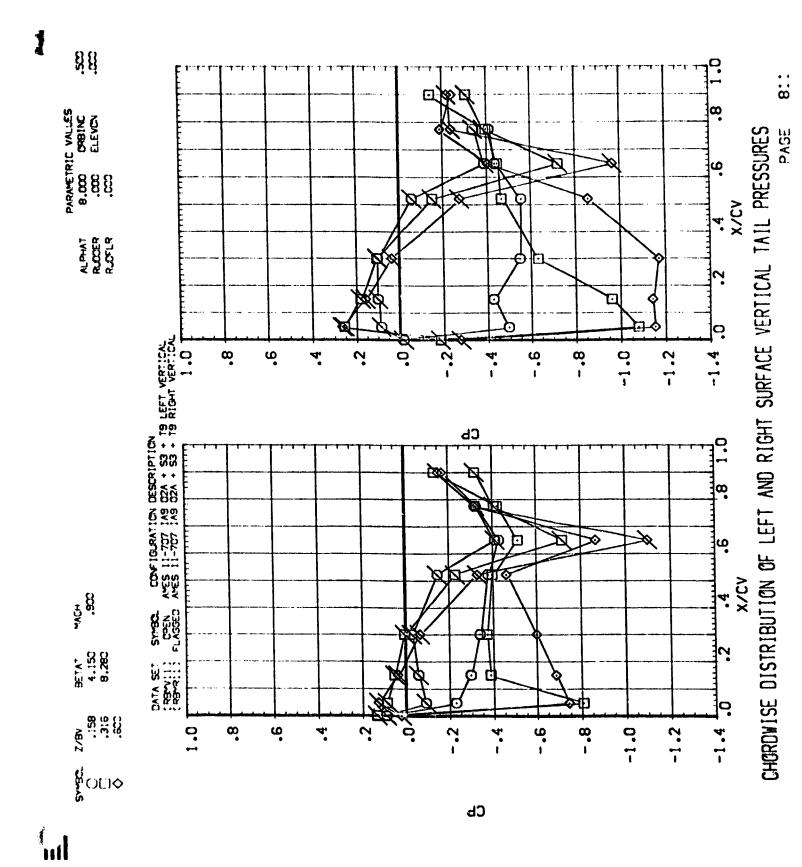


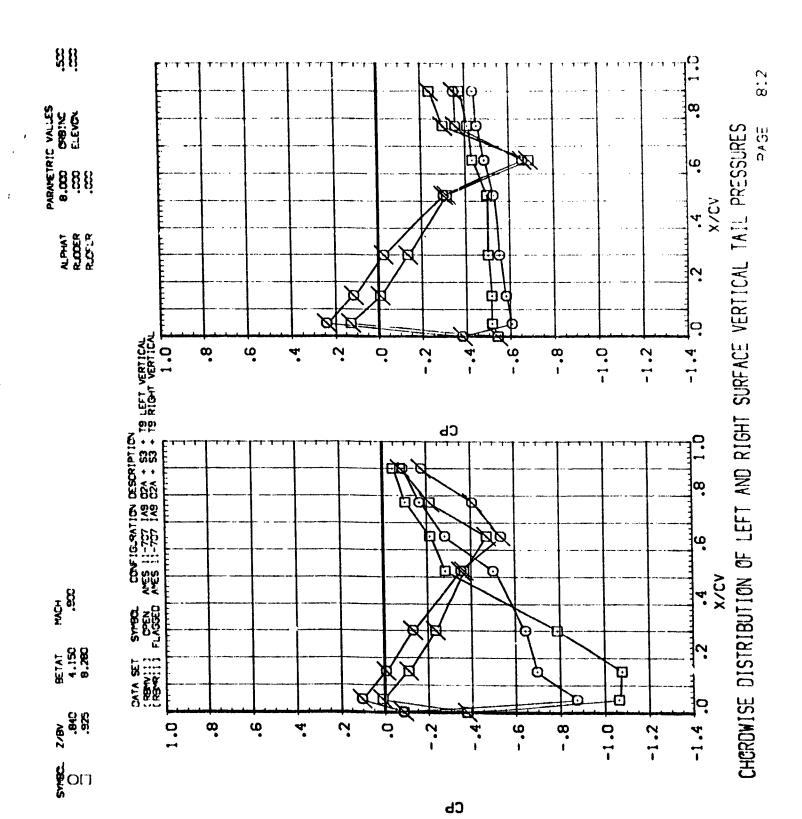




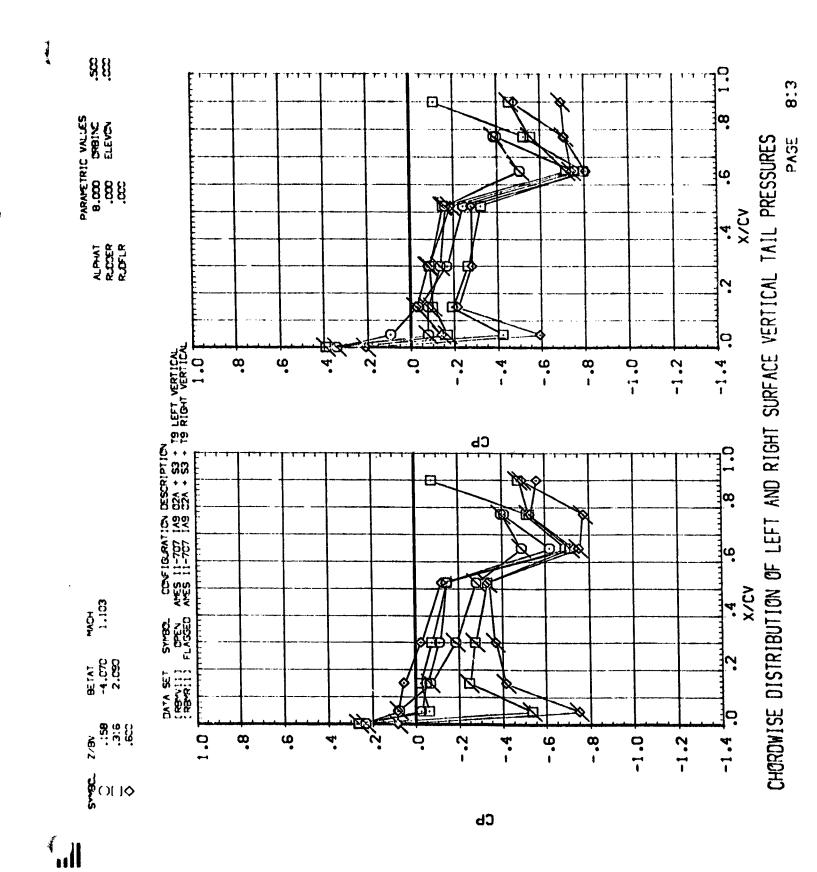
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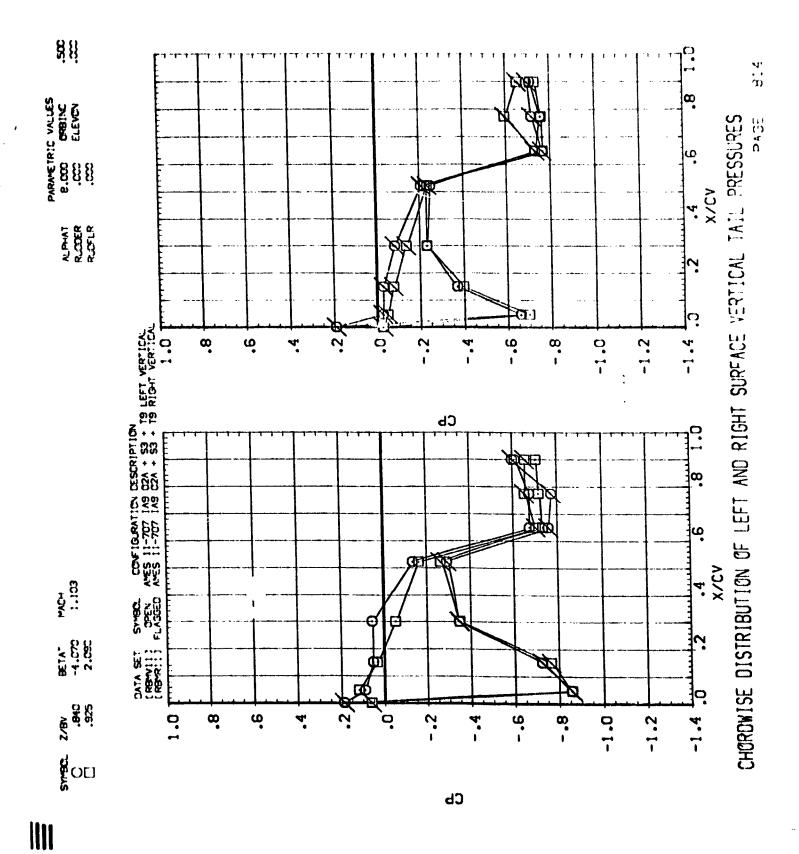
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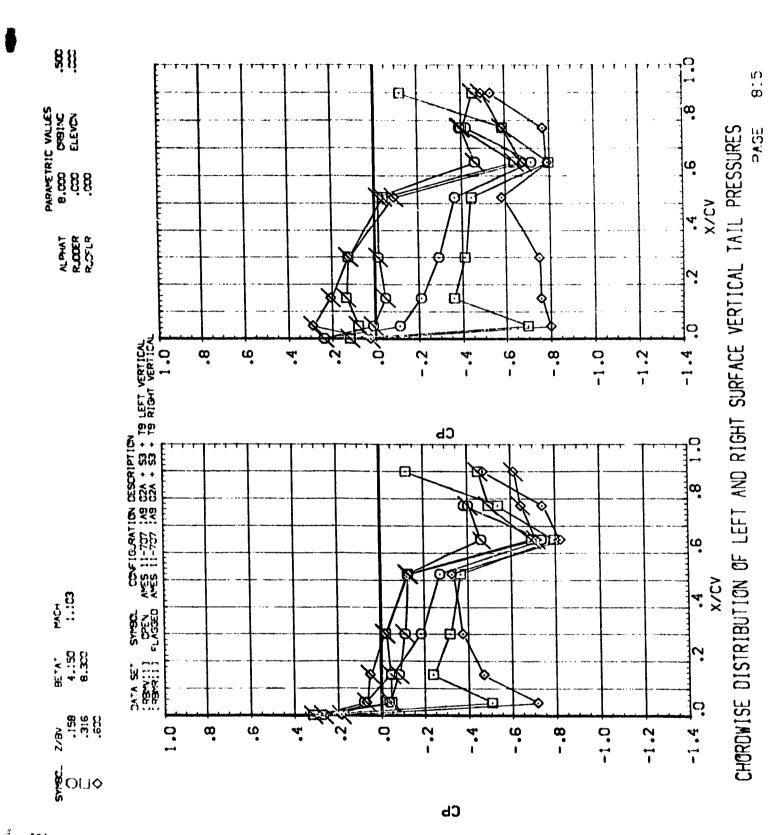
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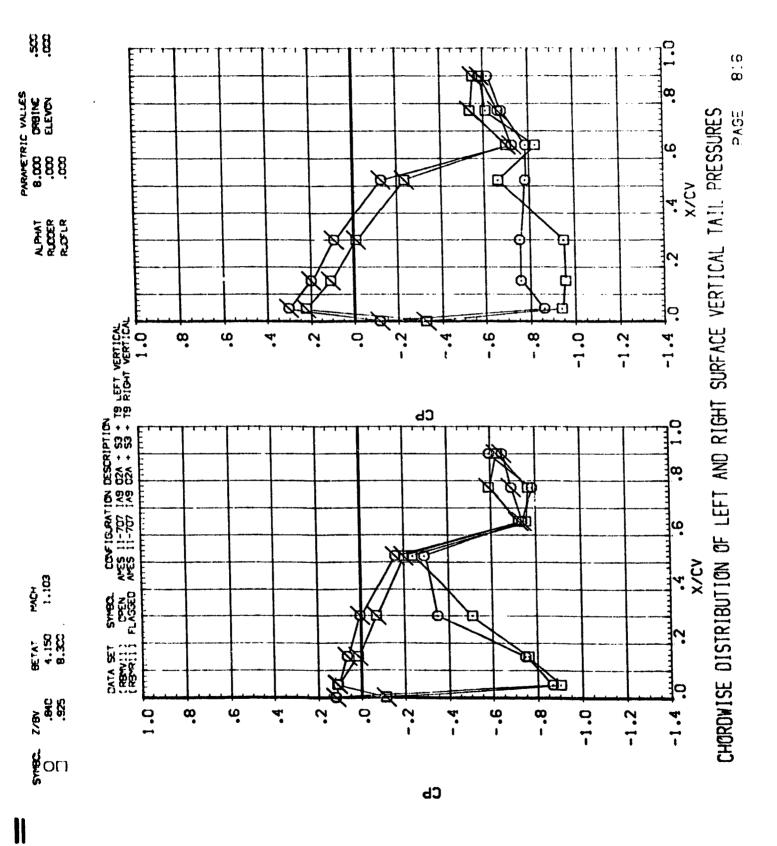


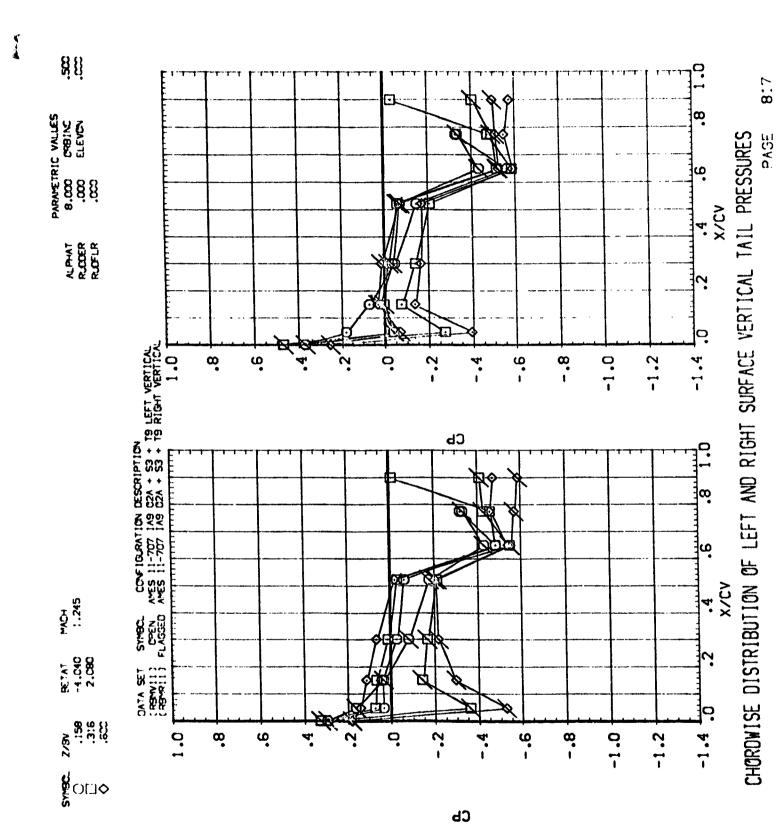


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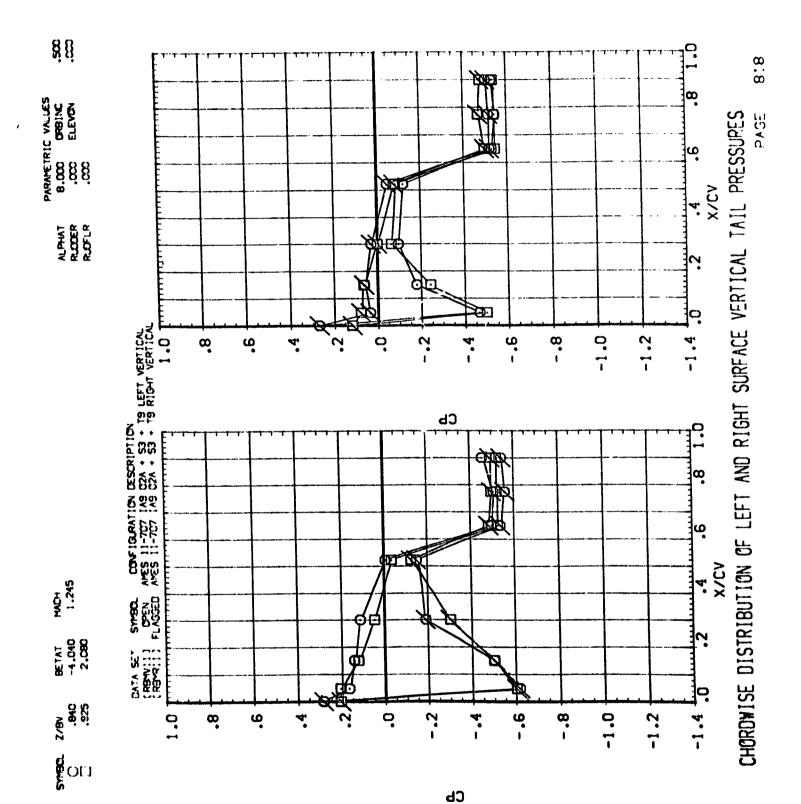
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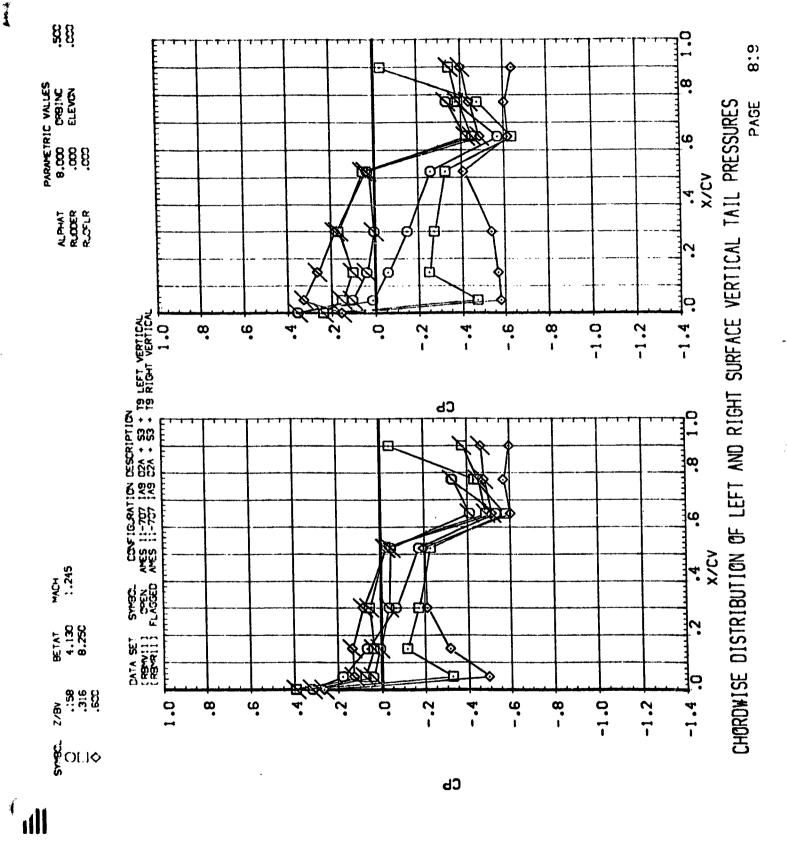


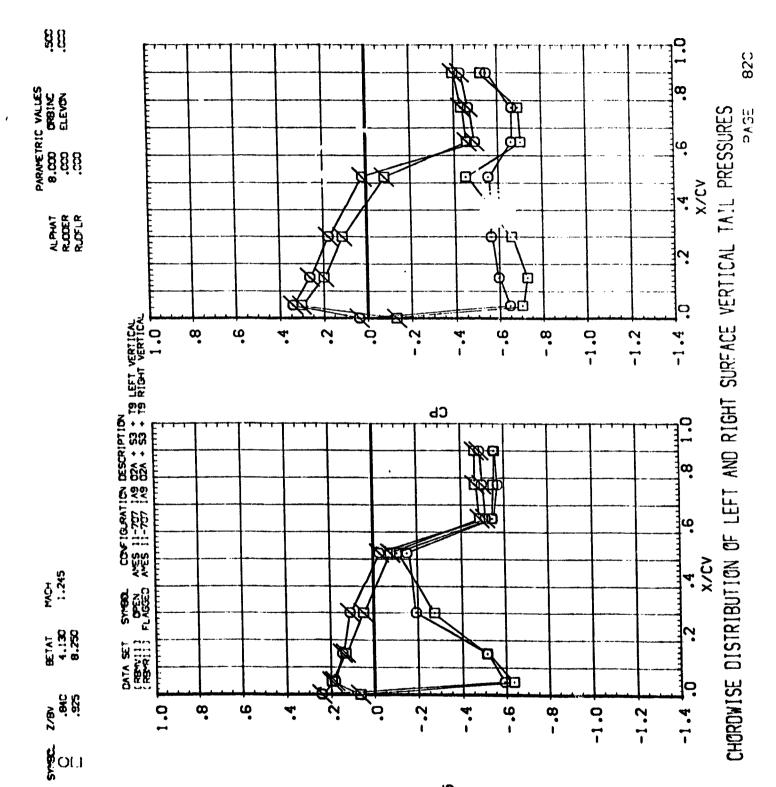


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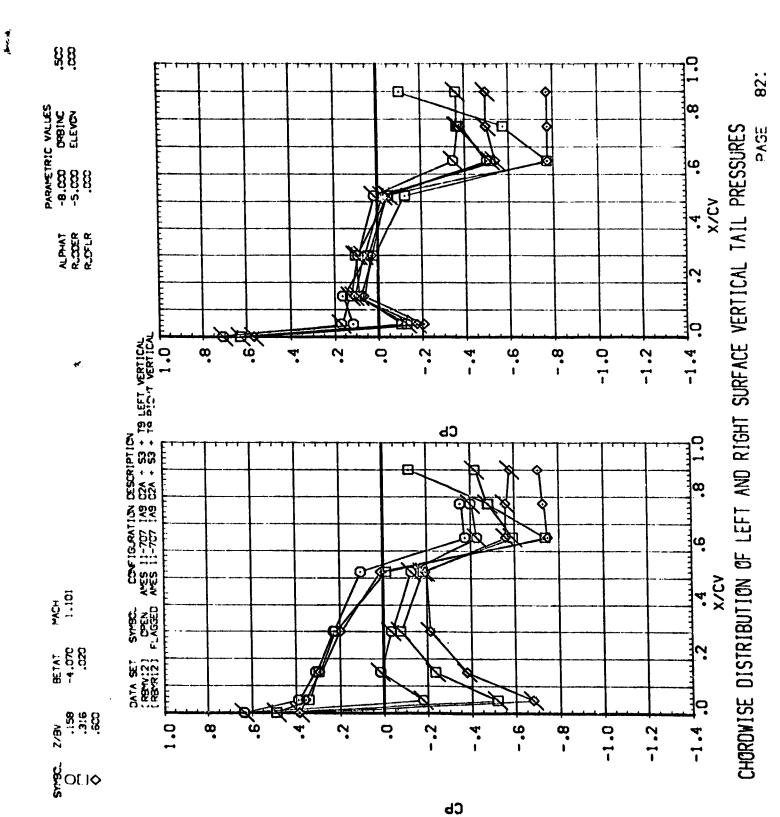




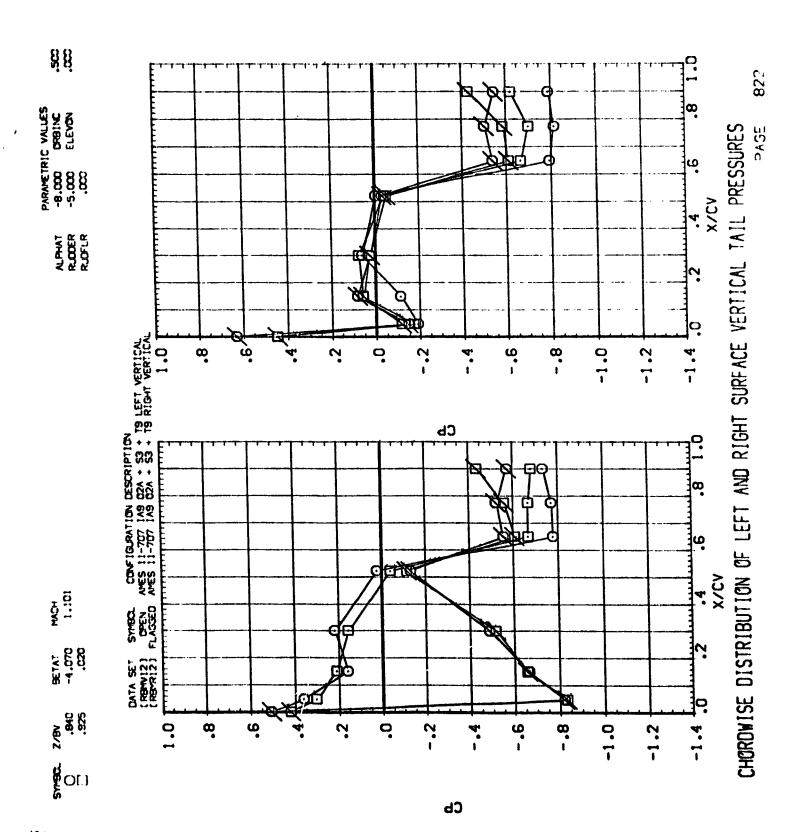




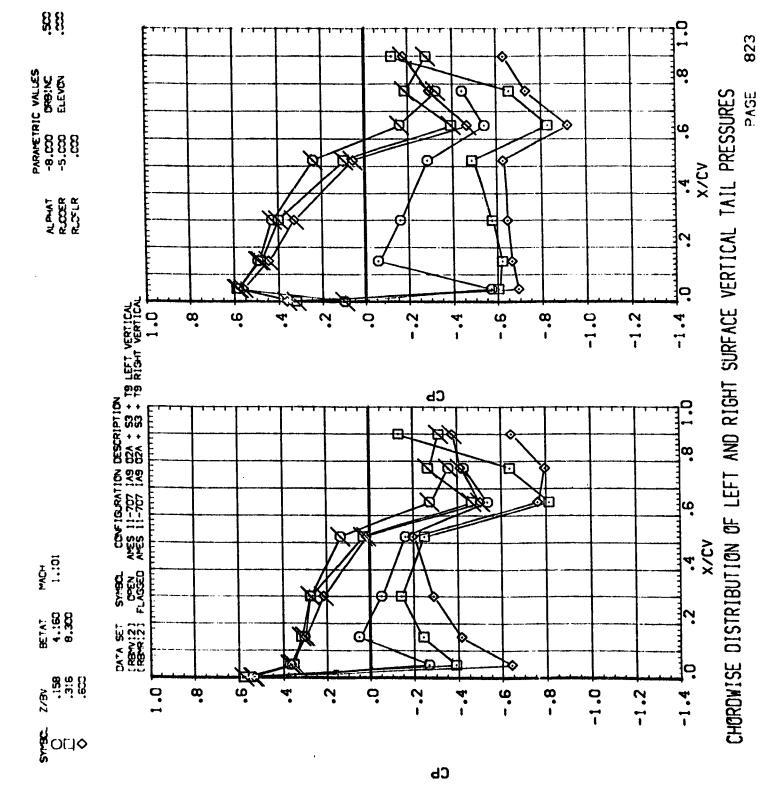
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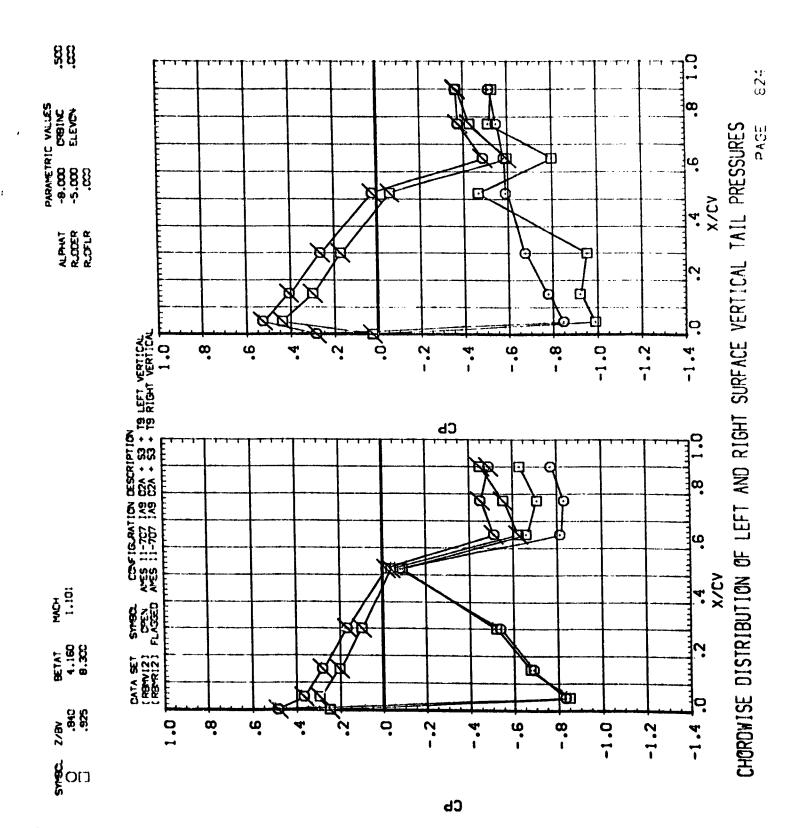


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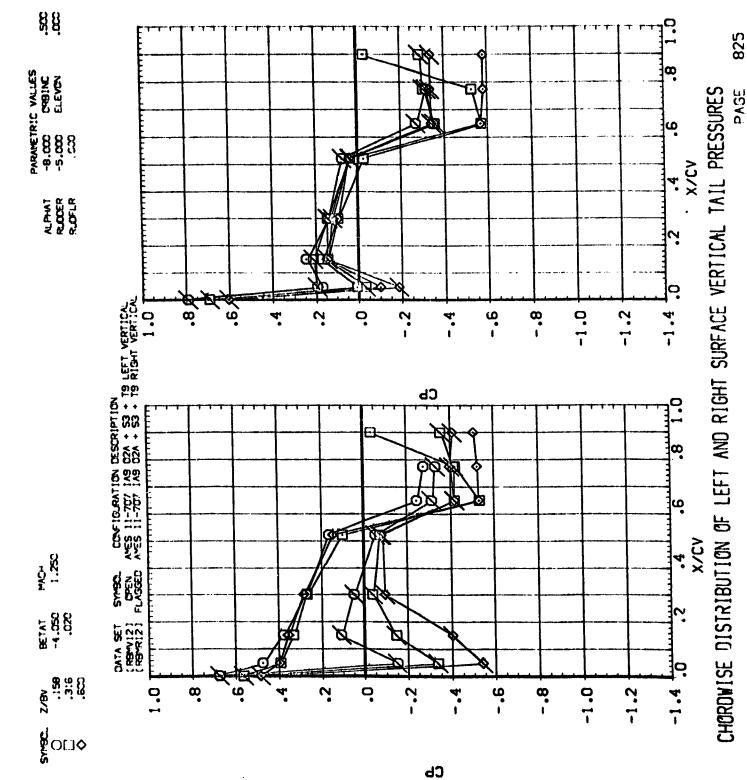




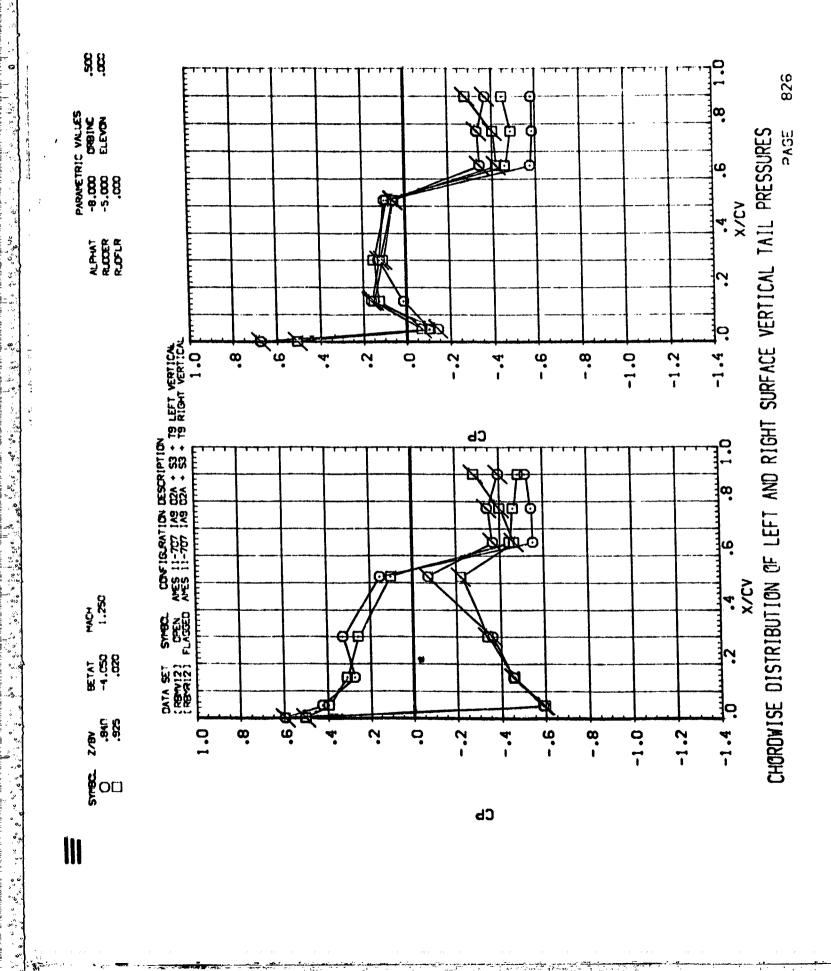


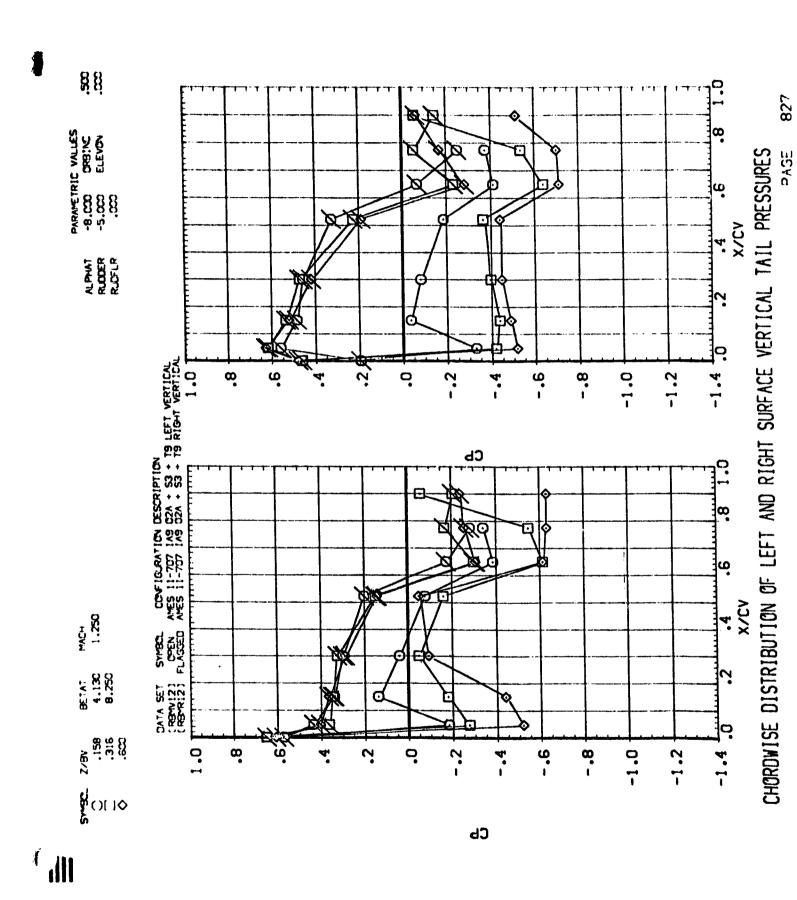


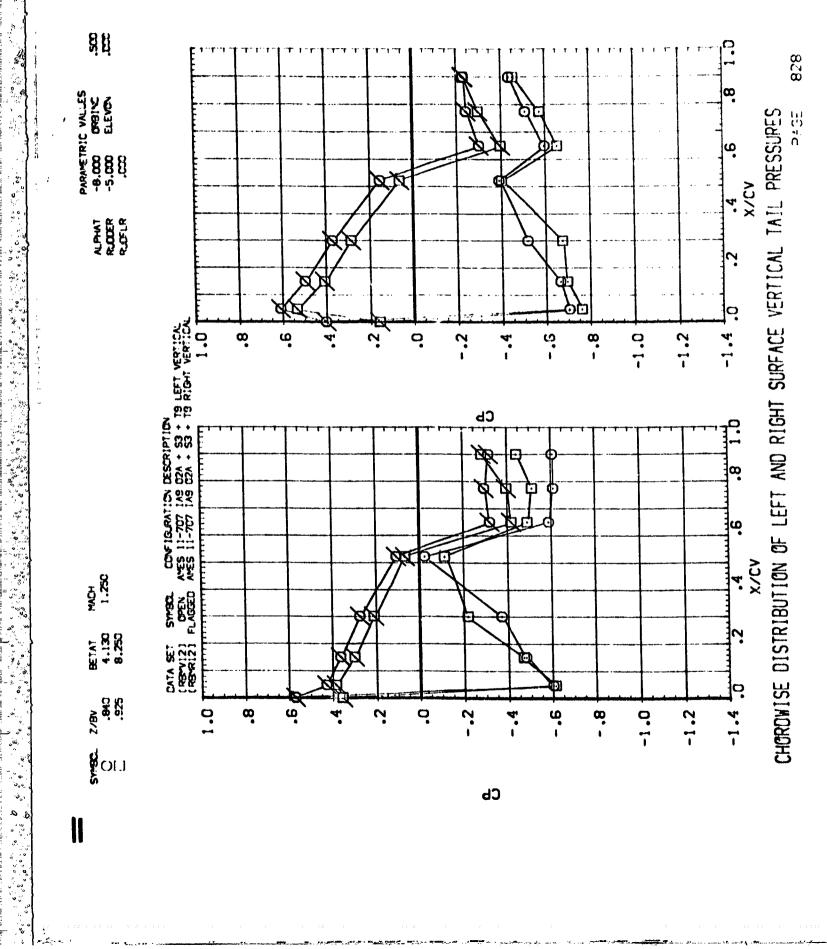


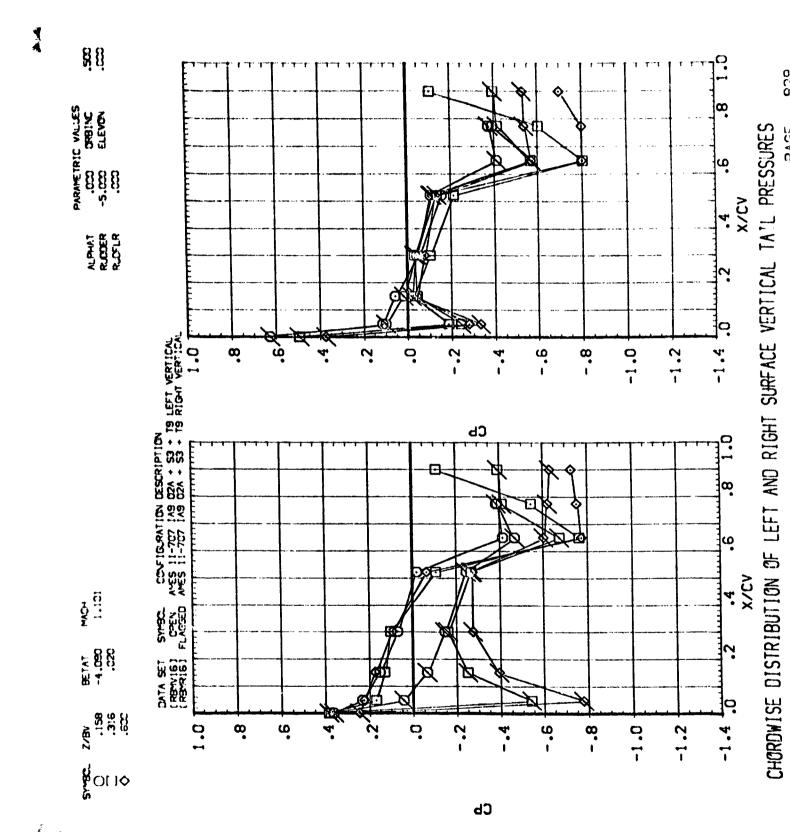


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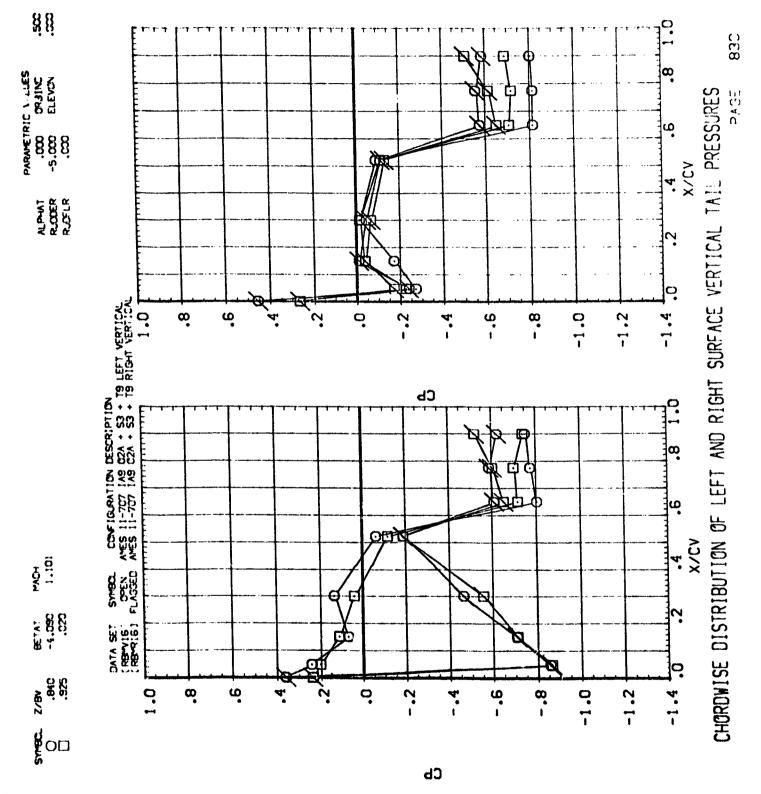






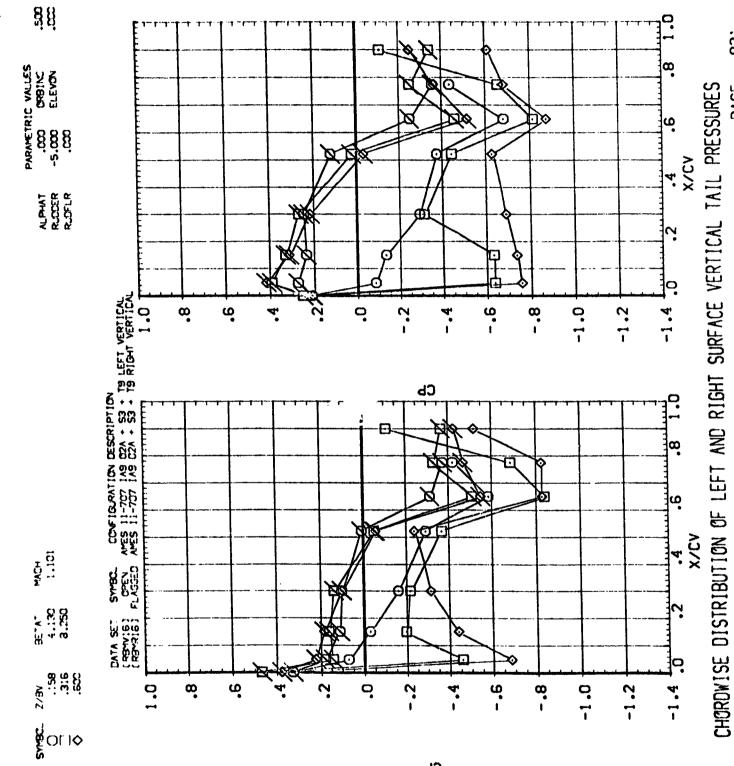


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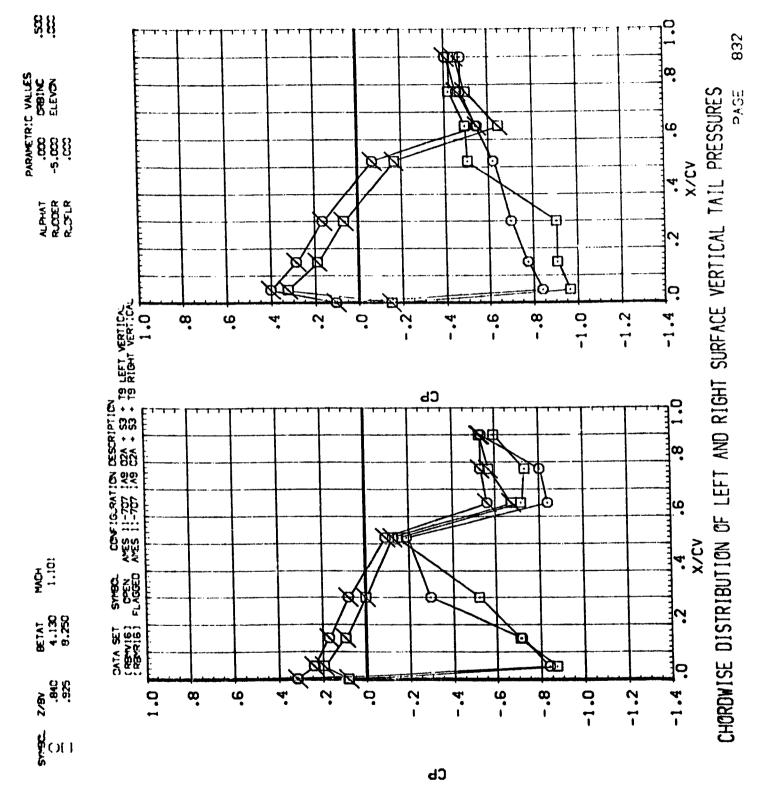




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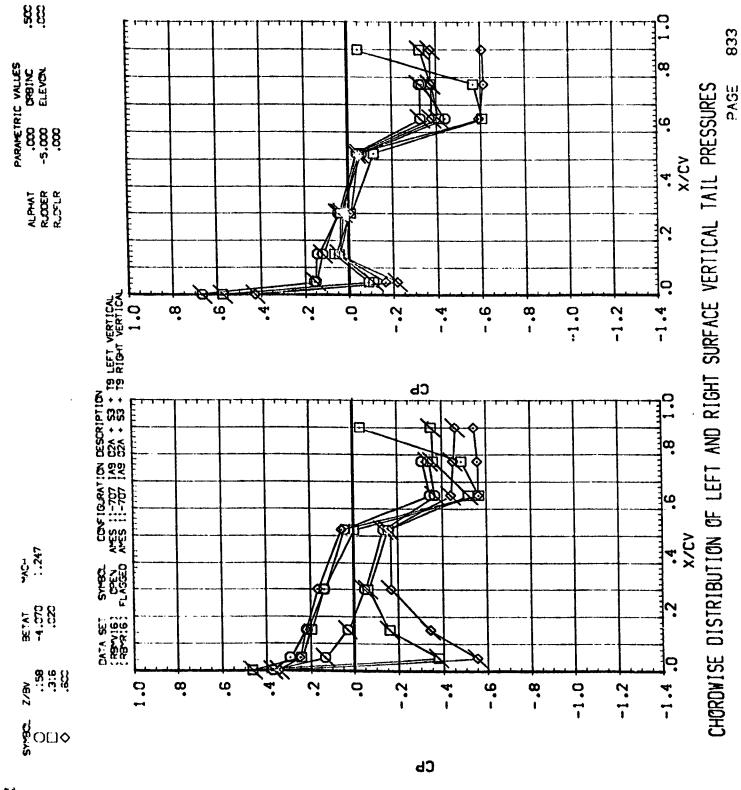
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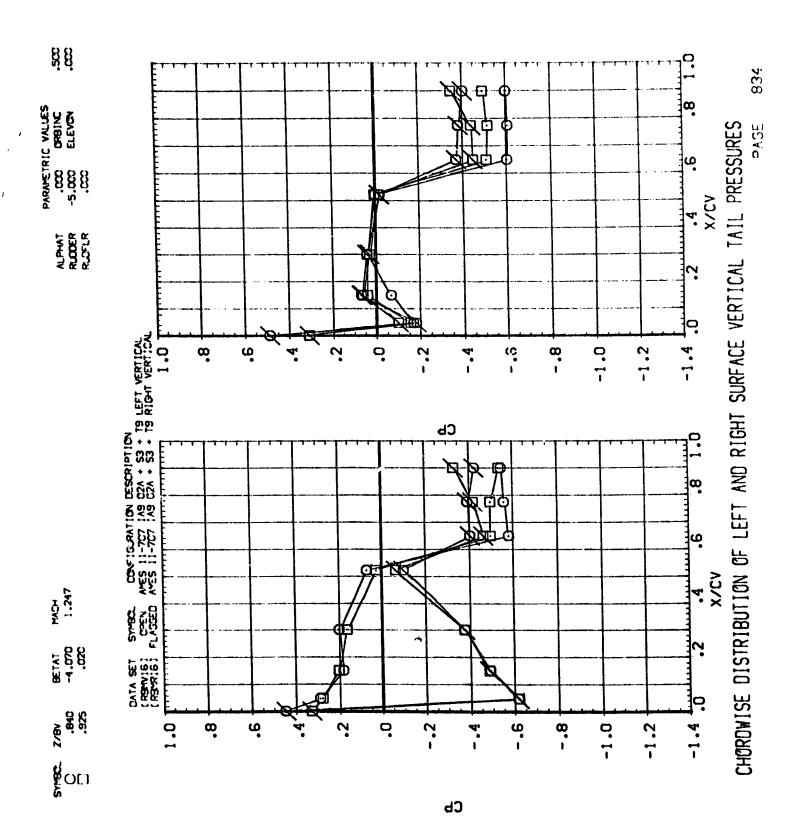
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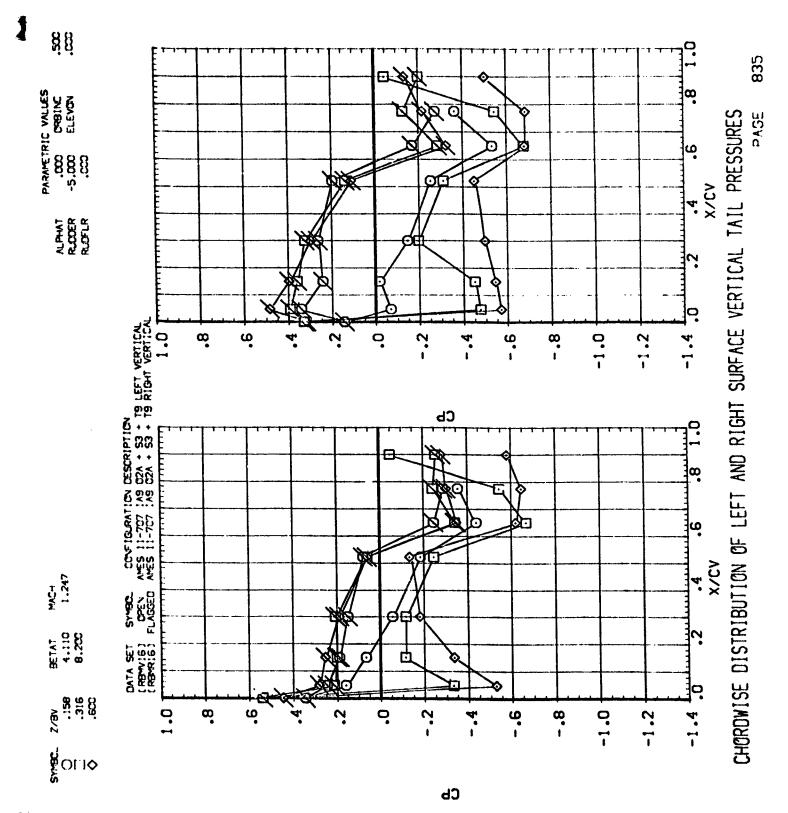
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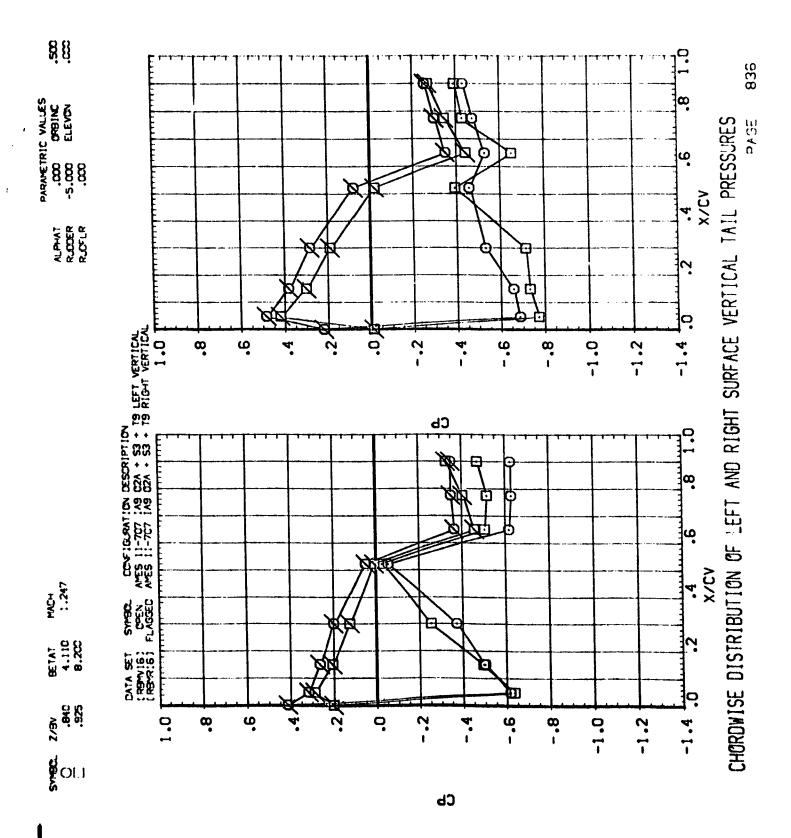


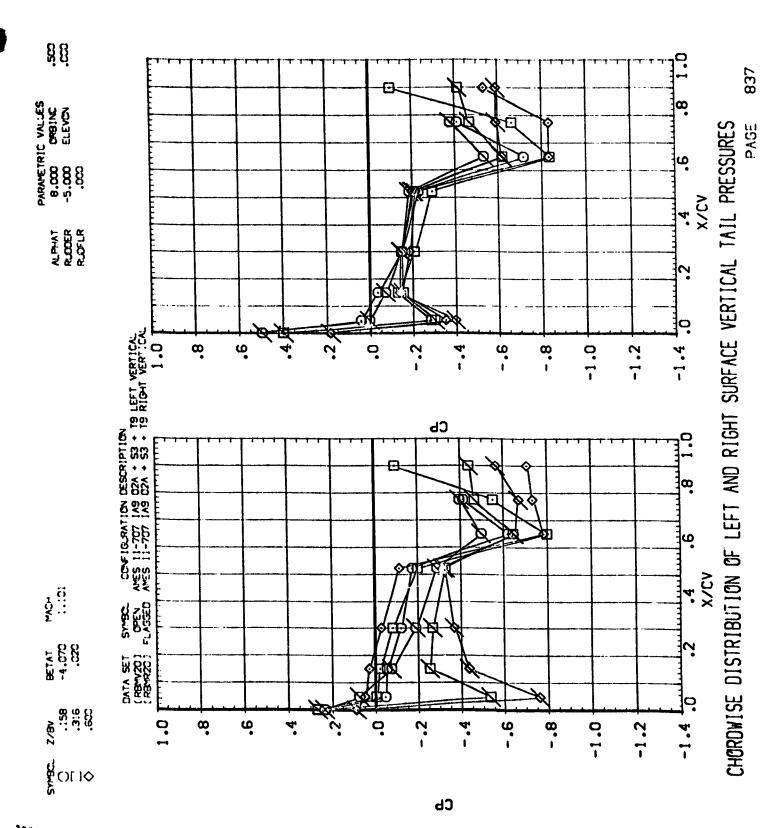
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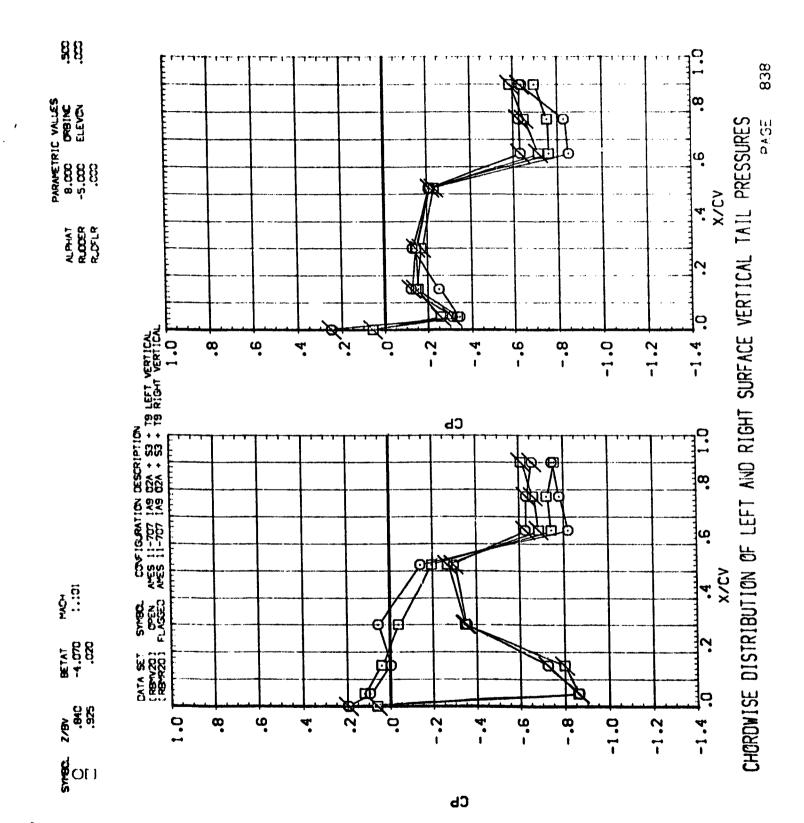
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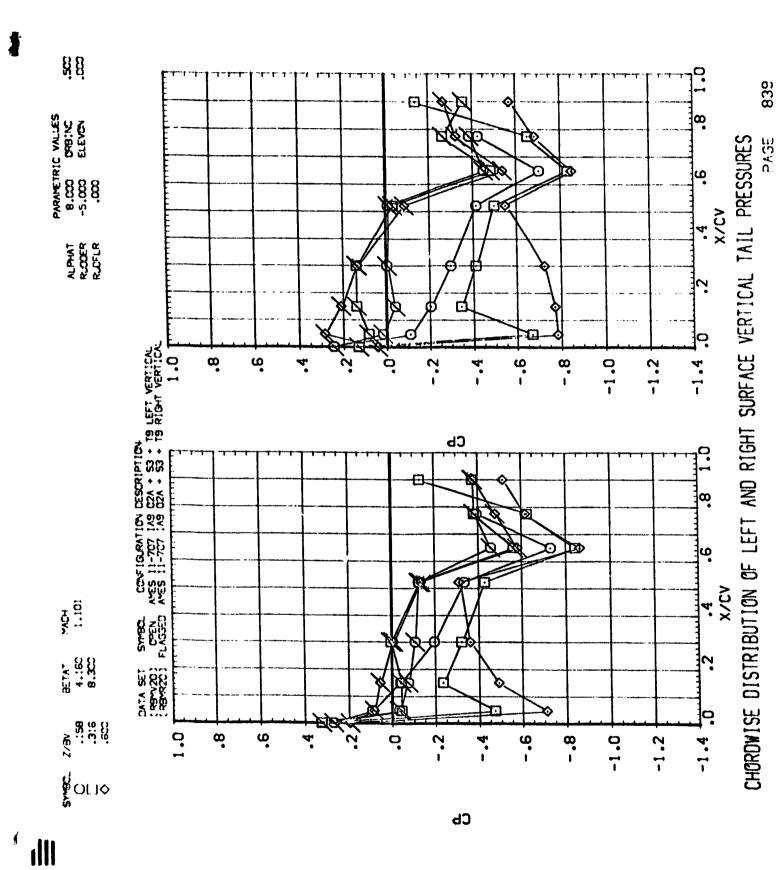


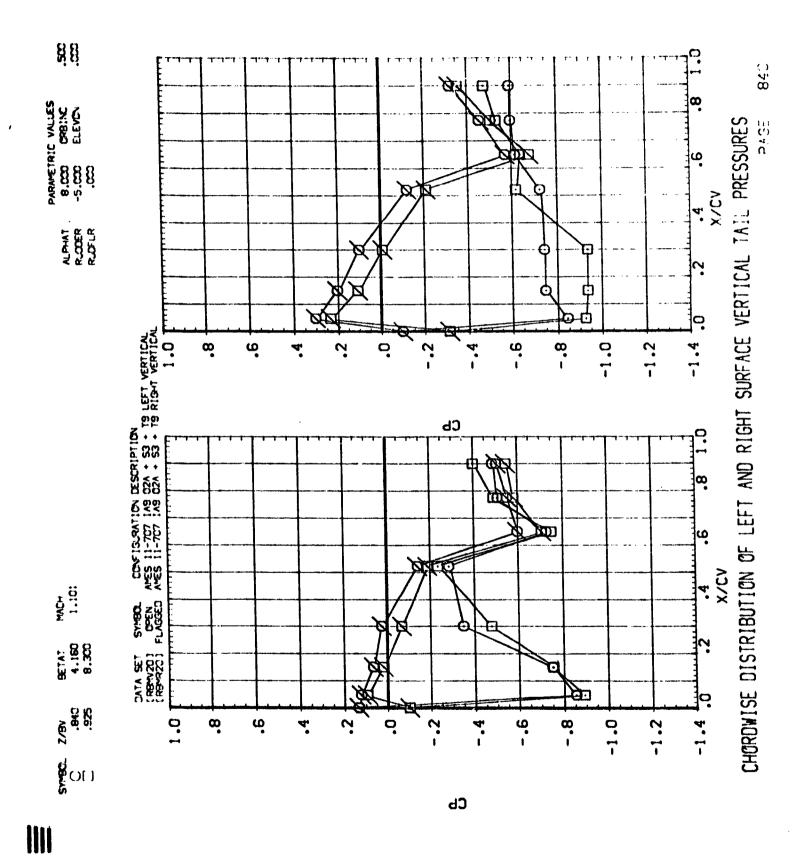
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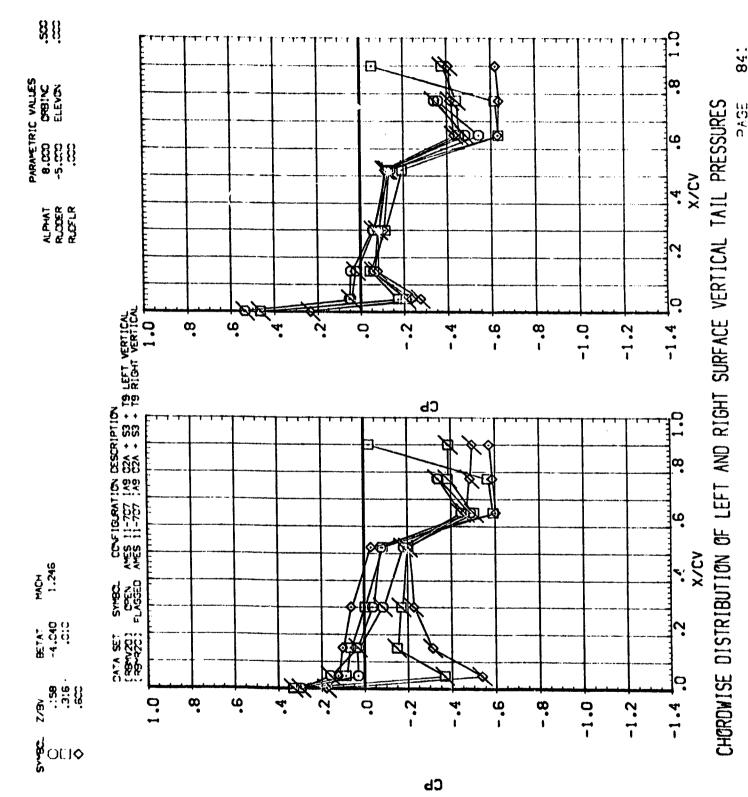










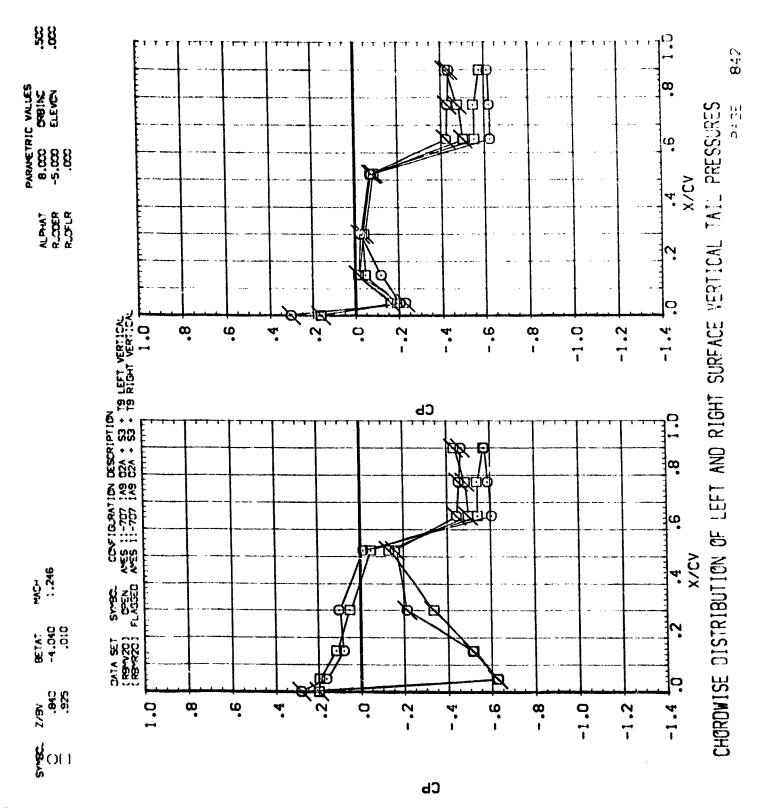


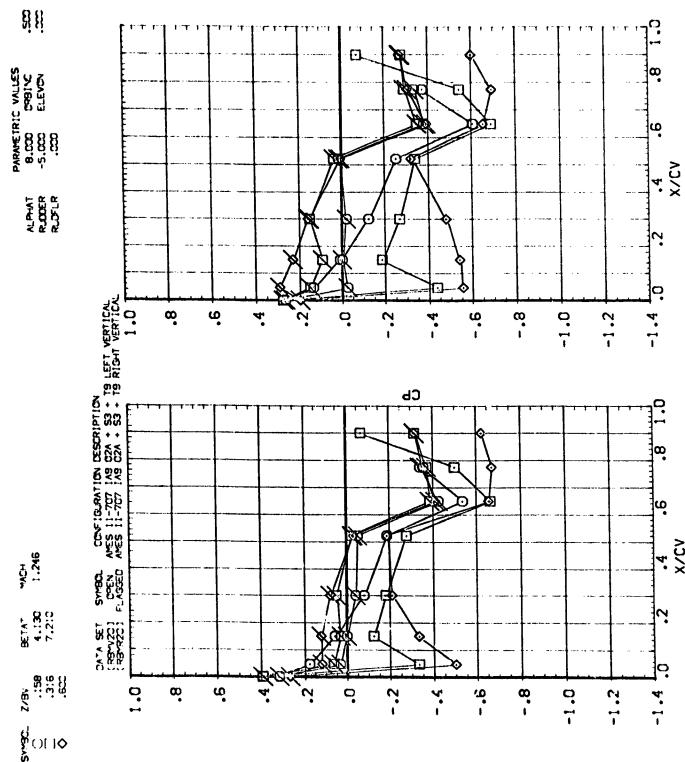
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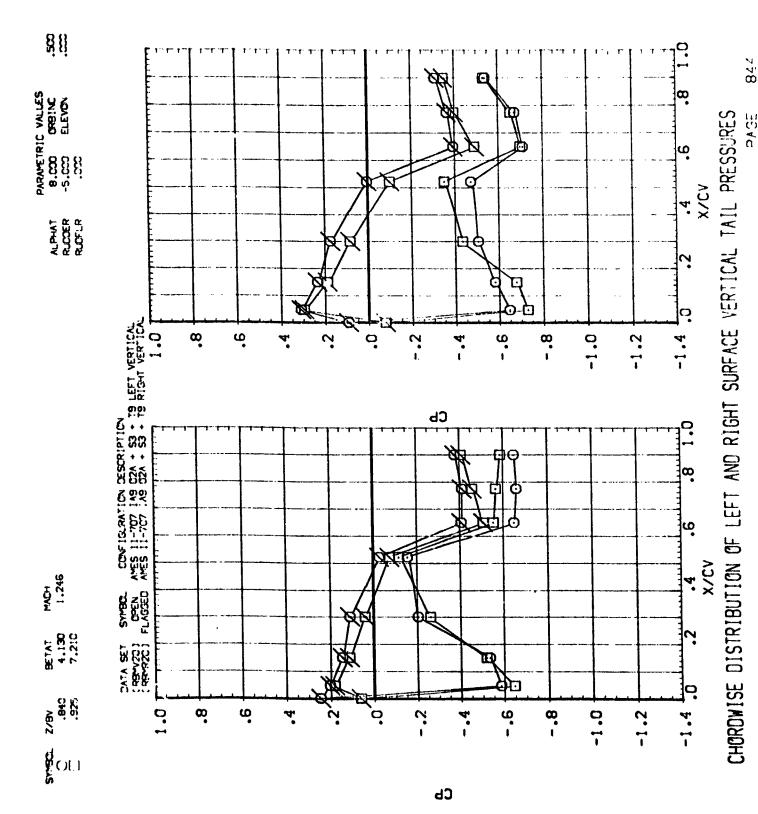




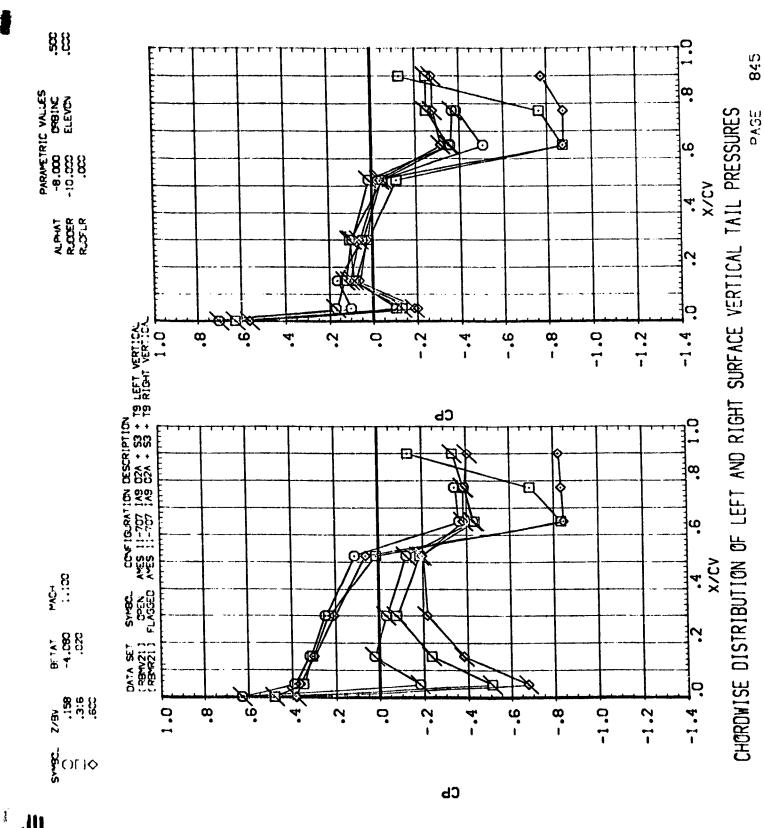
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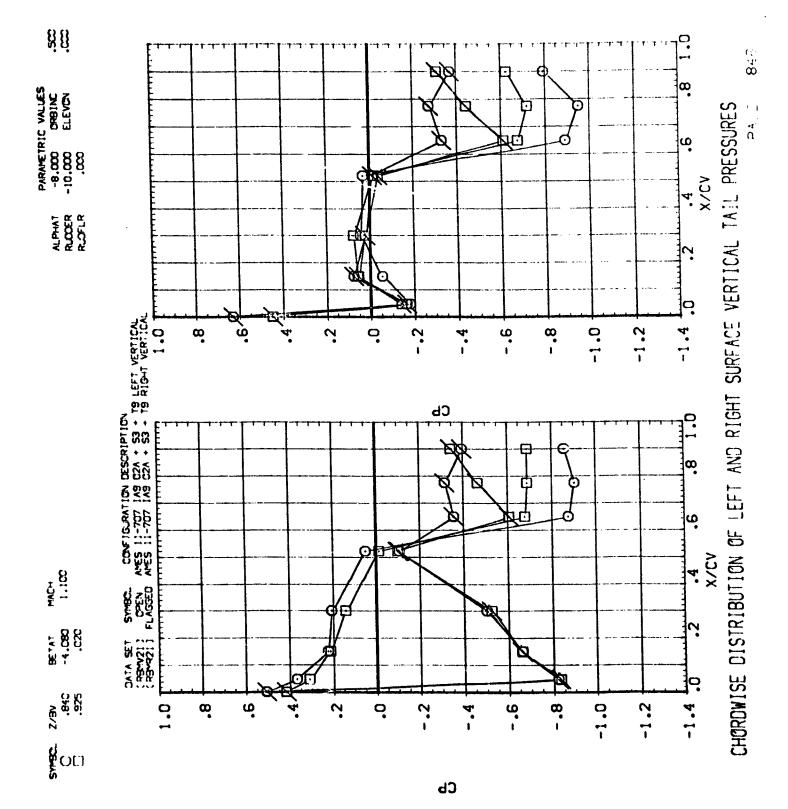


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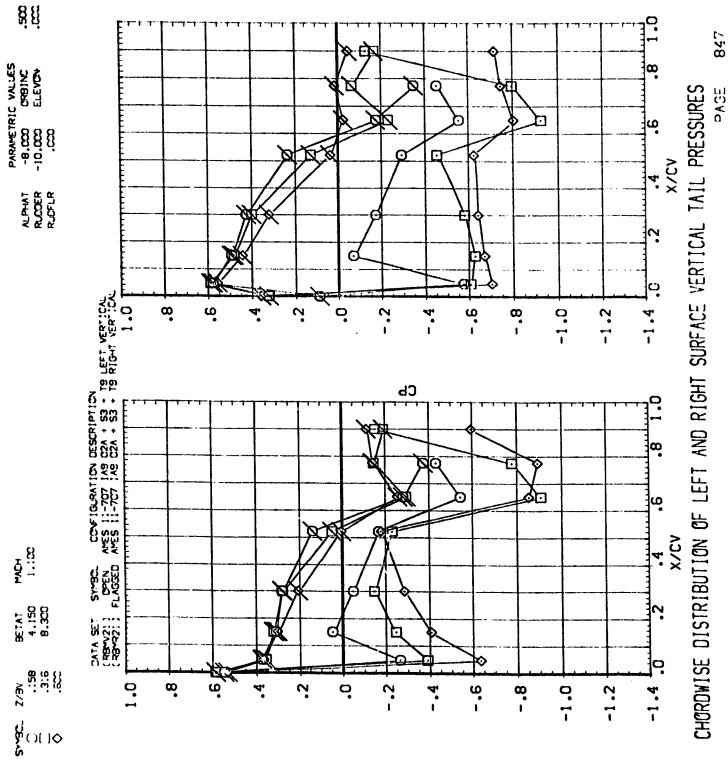
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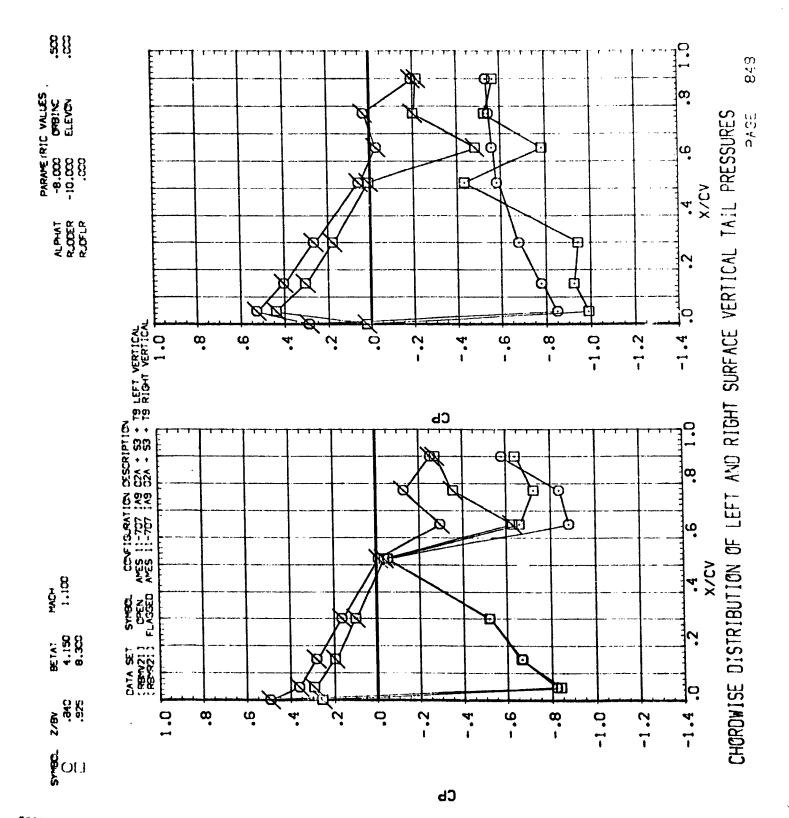
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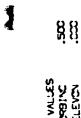


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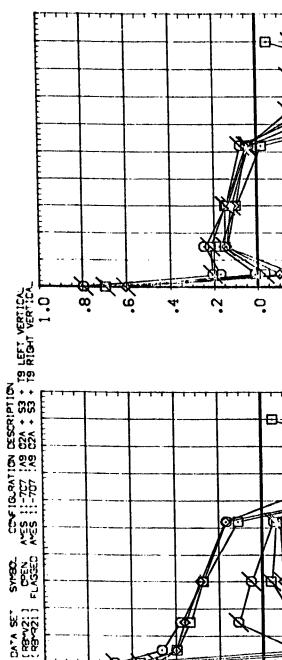


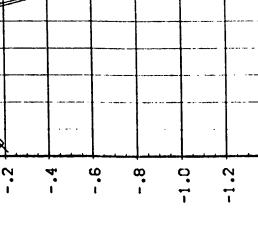




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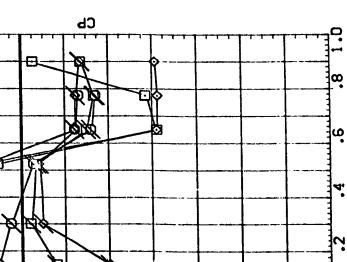
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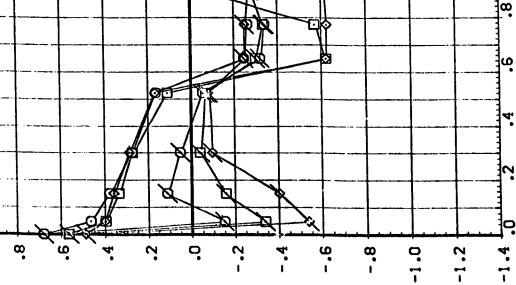
CHORDWISE DISTRIBUTION OF LEFT AND RIGHT SURFACE VERTICAL TAIL PRESSURES

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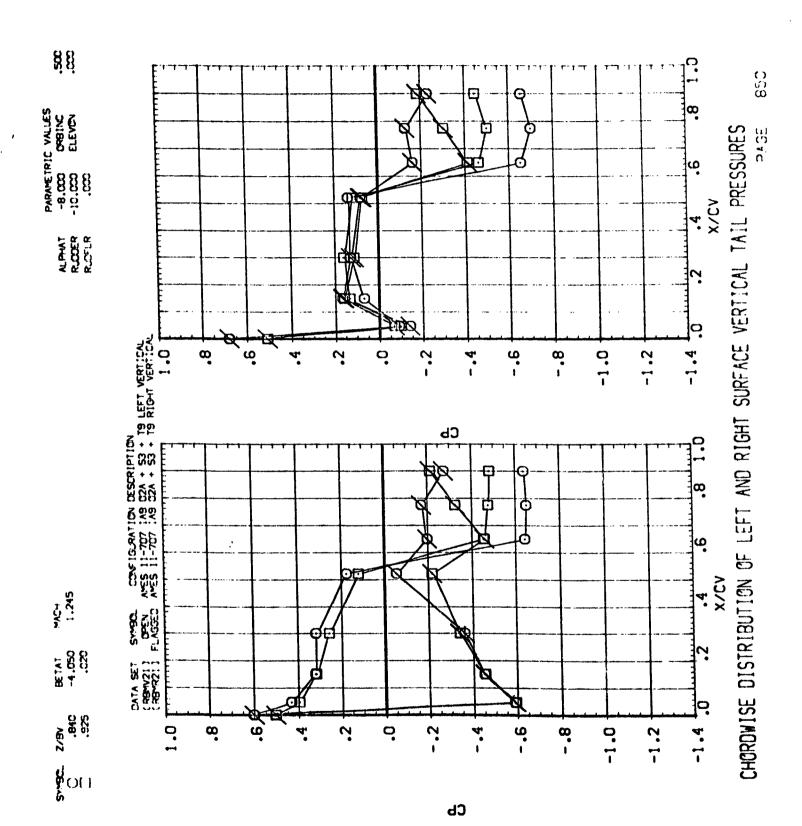


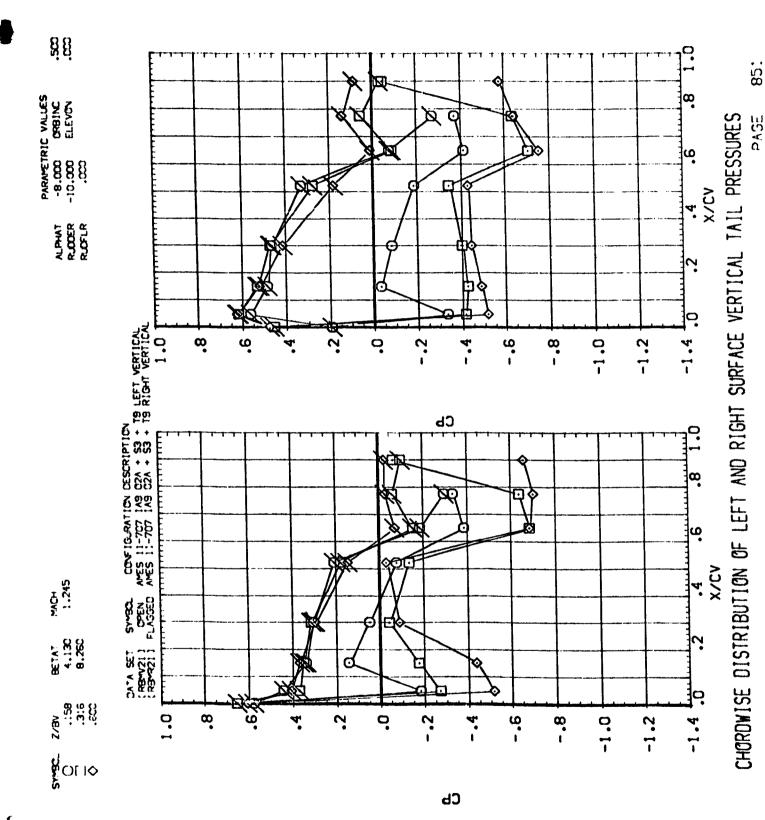






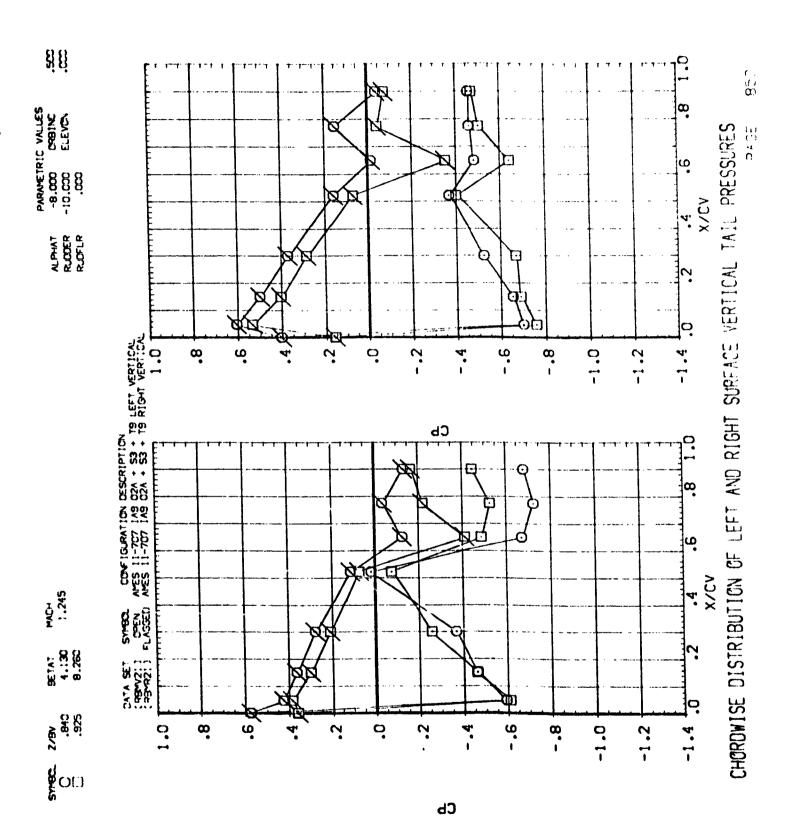


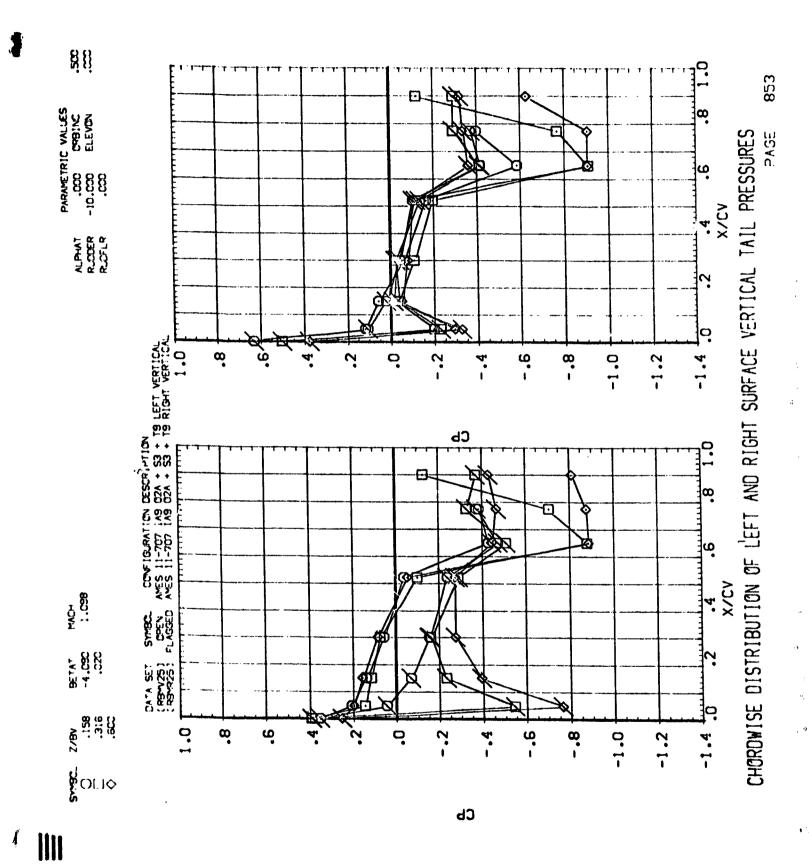


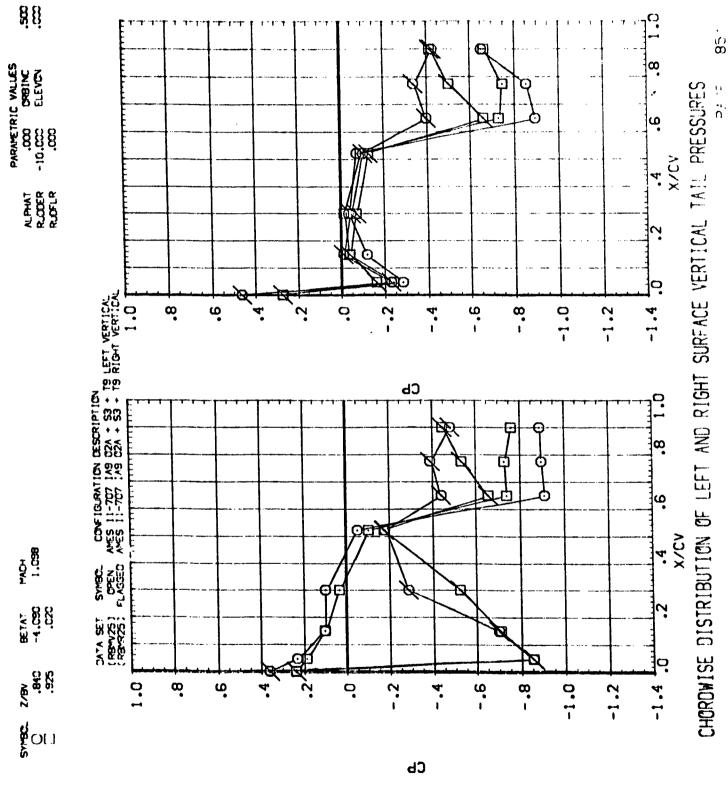


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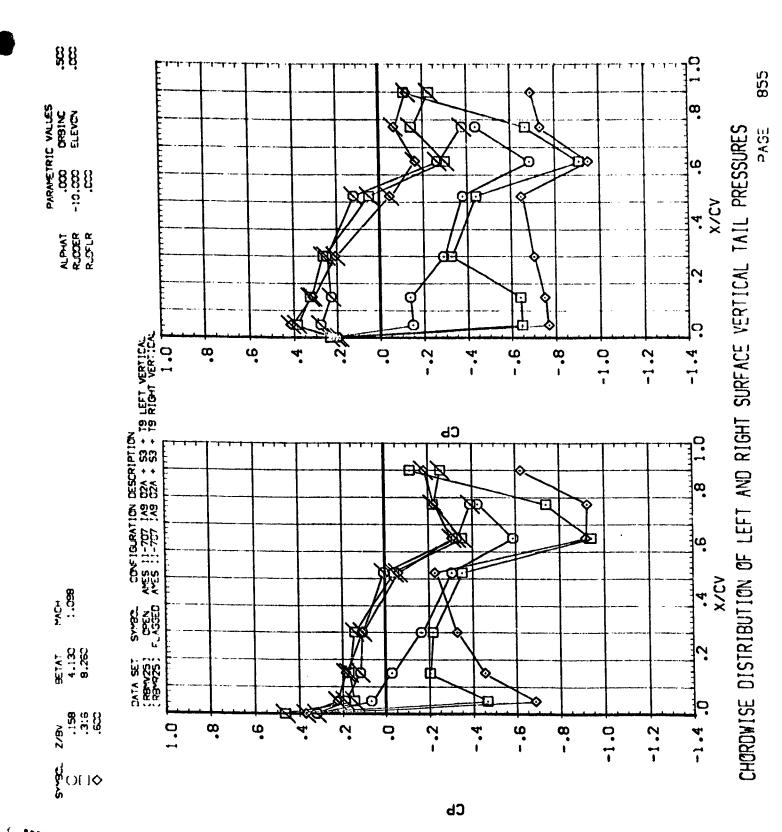
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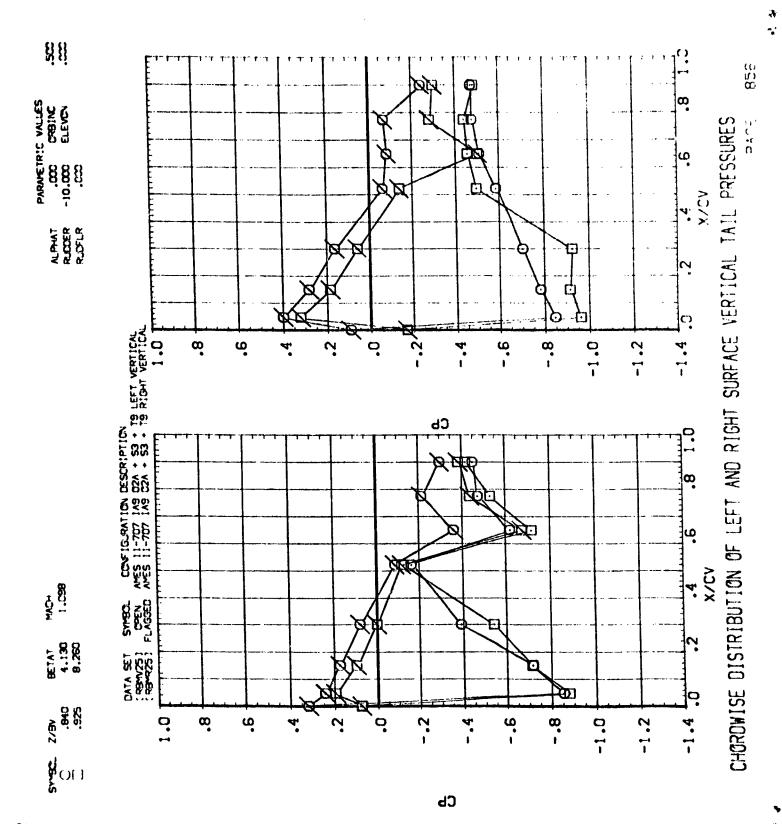


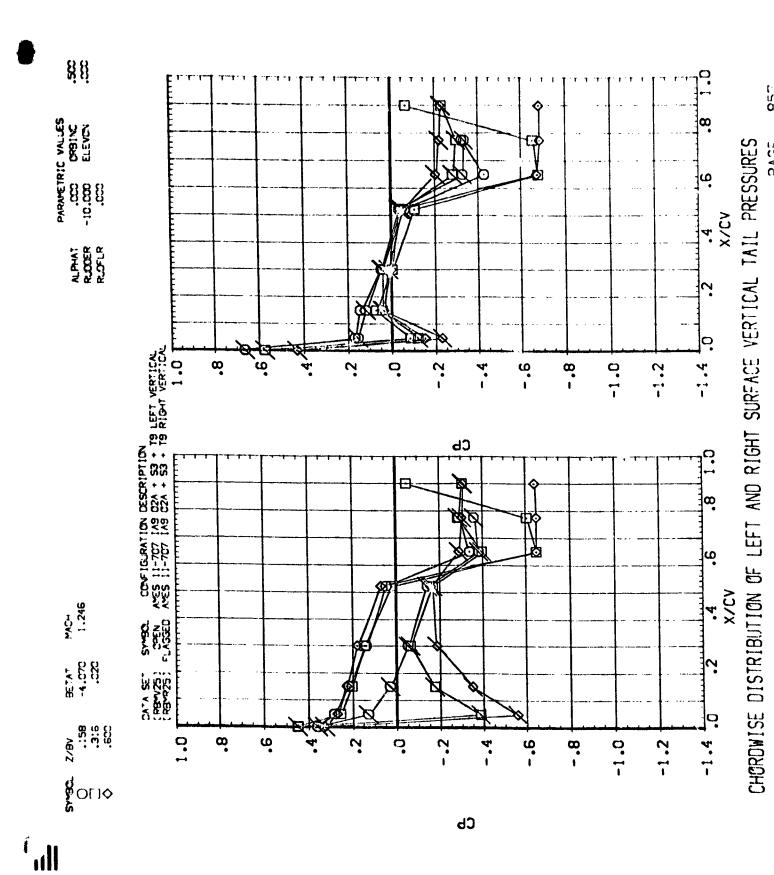


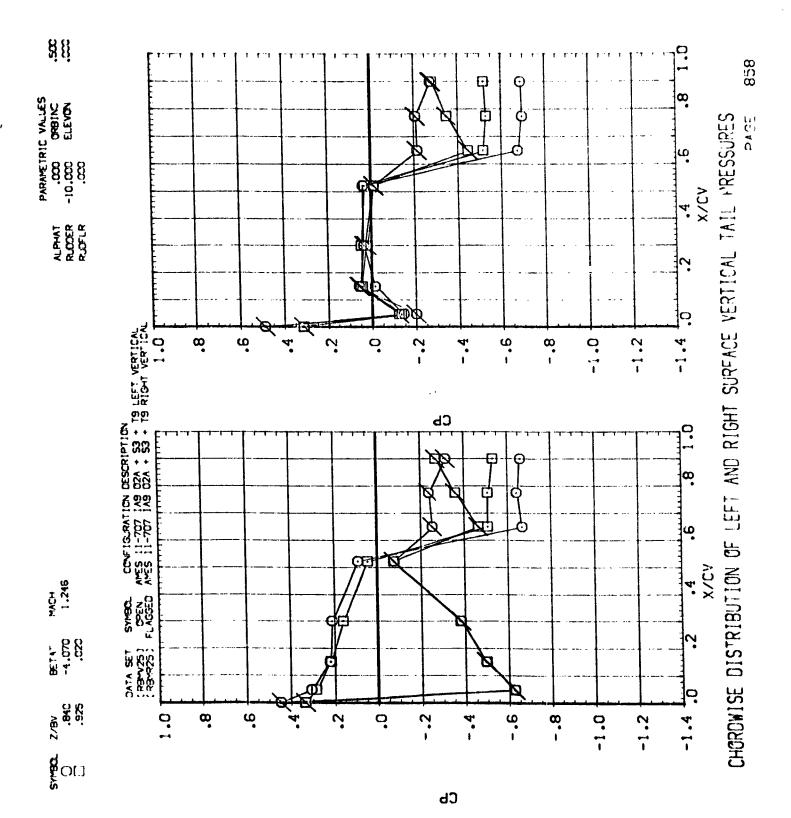
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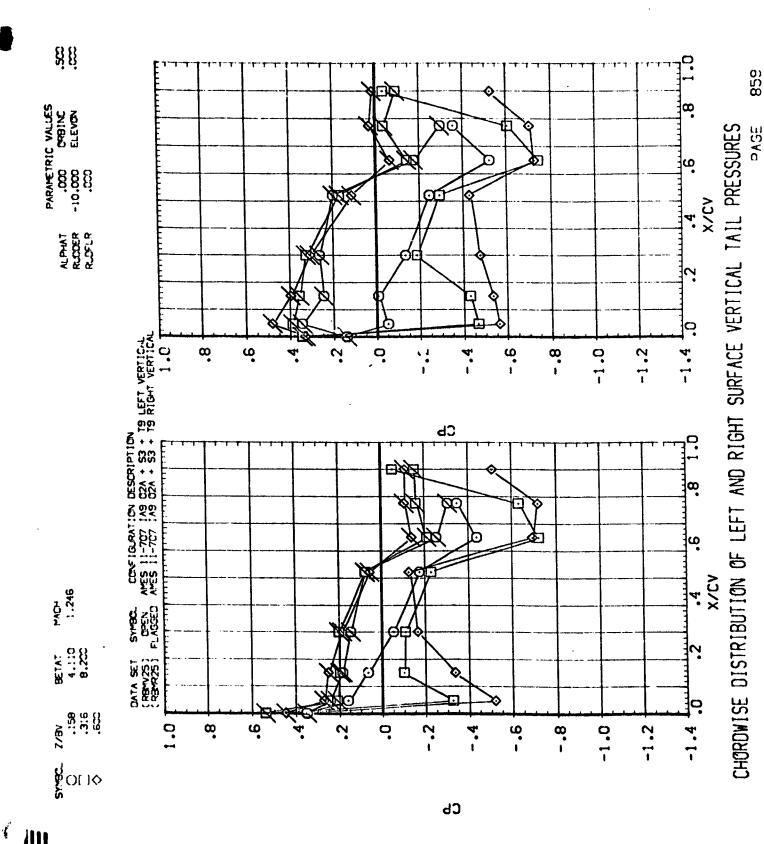


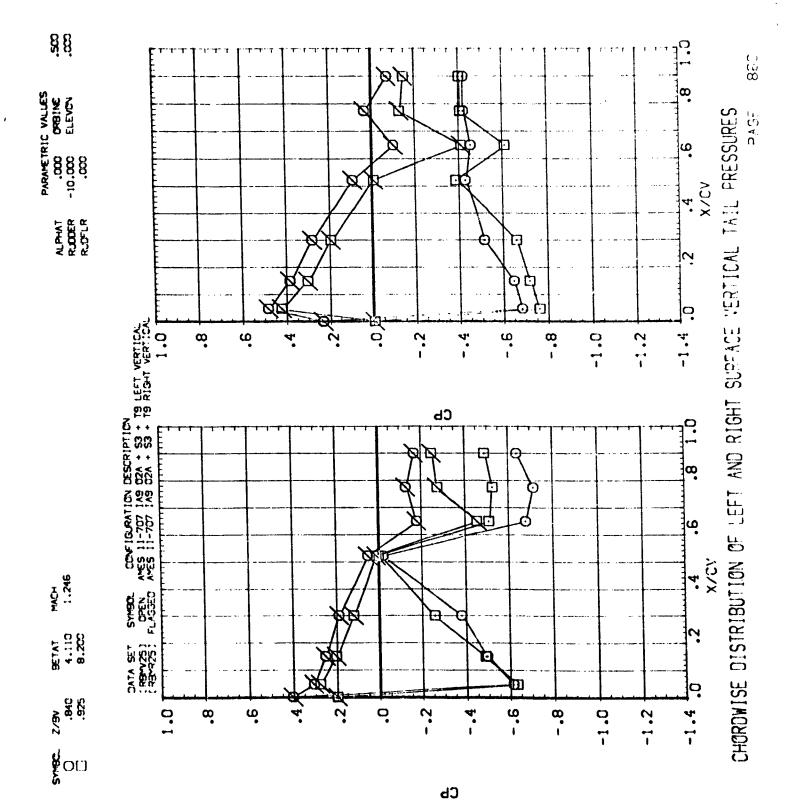
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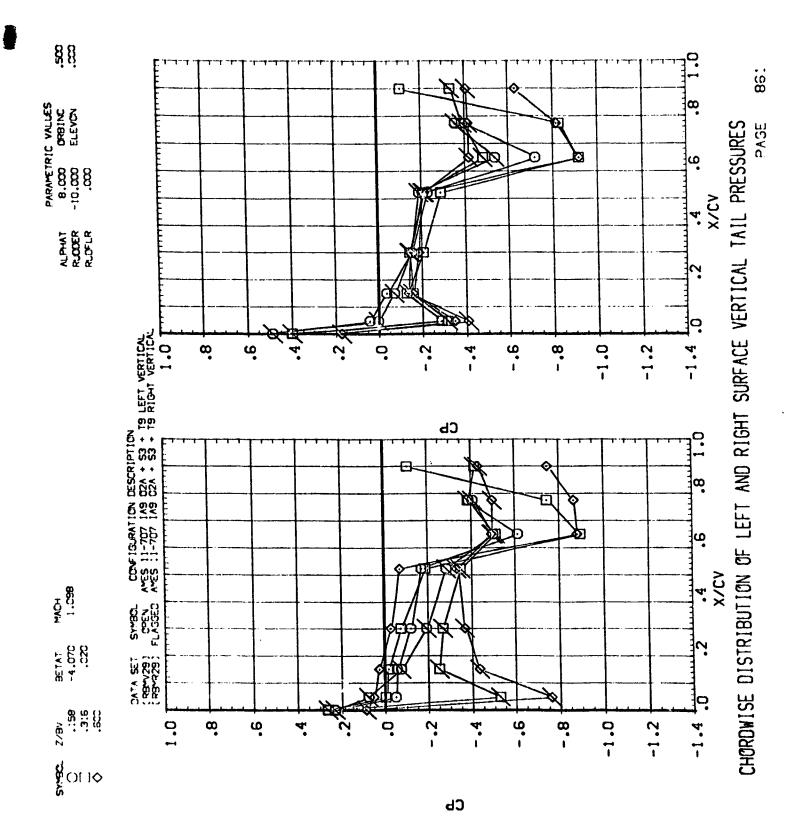


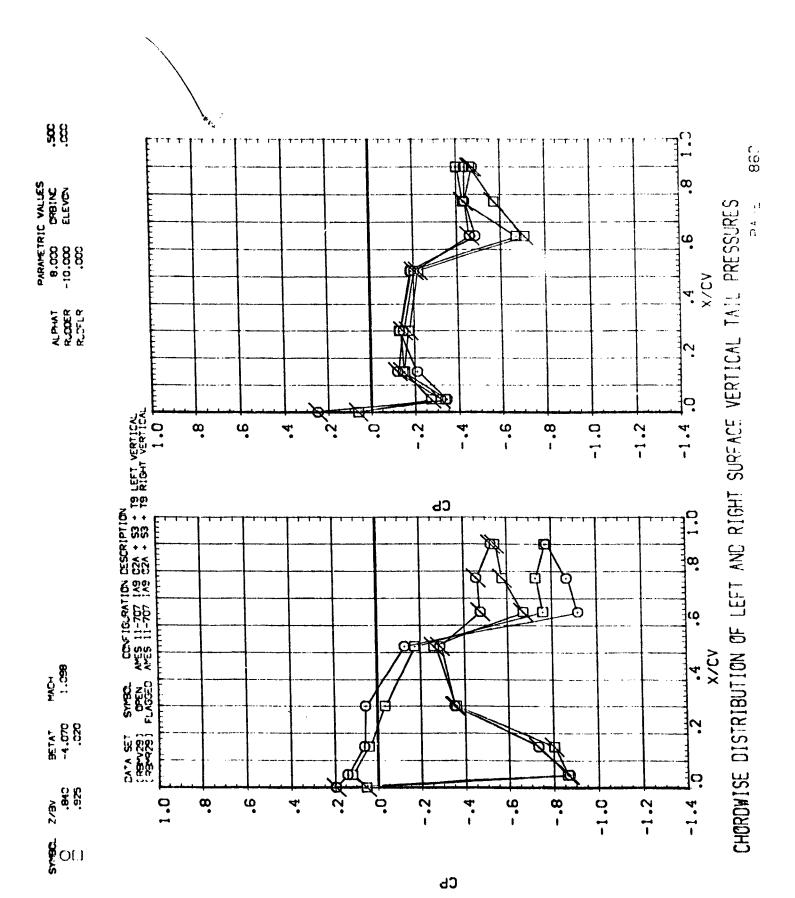


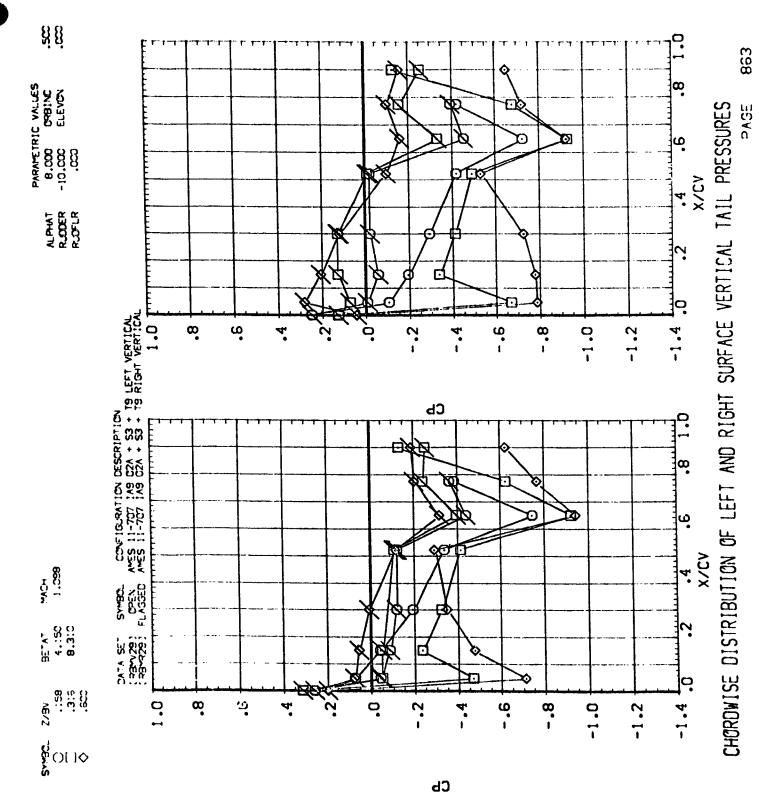


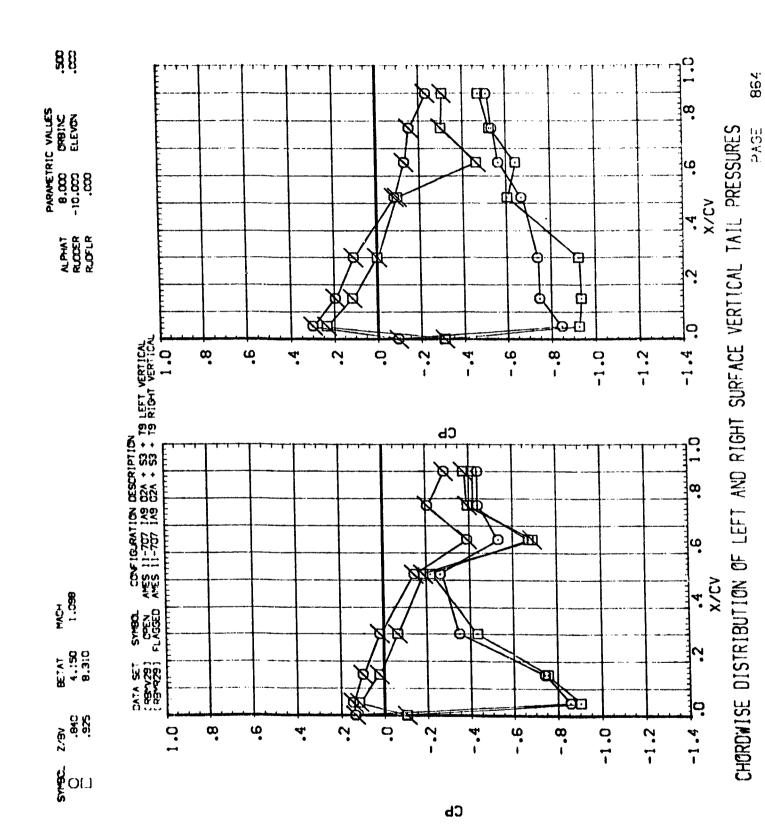


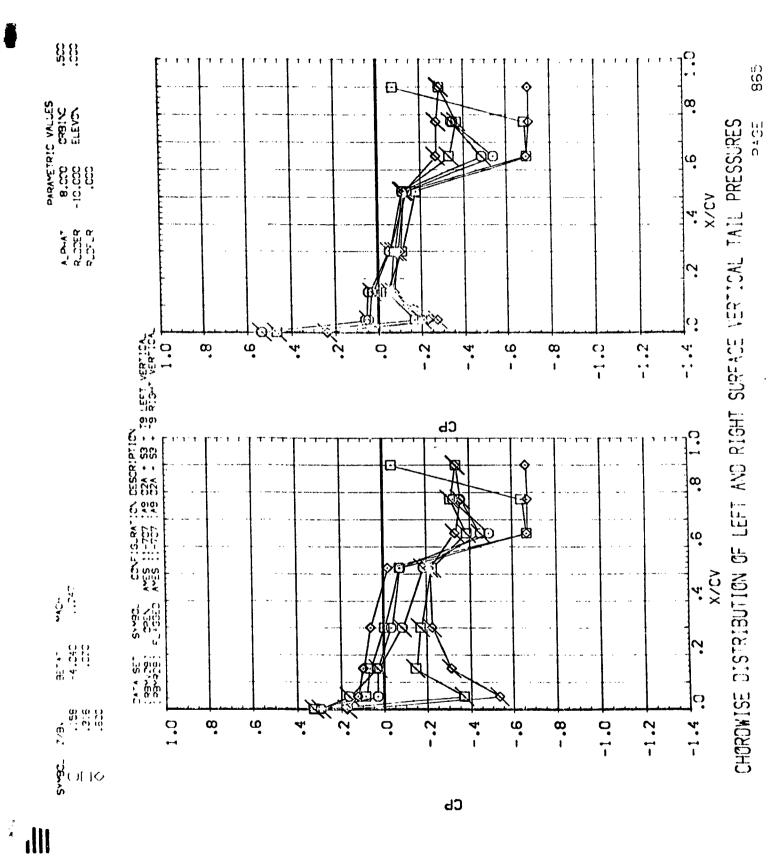
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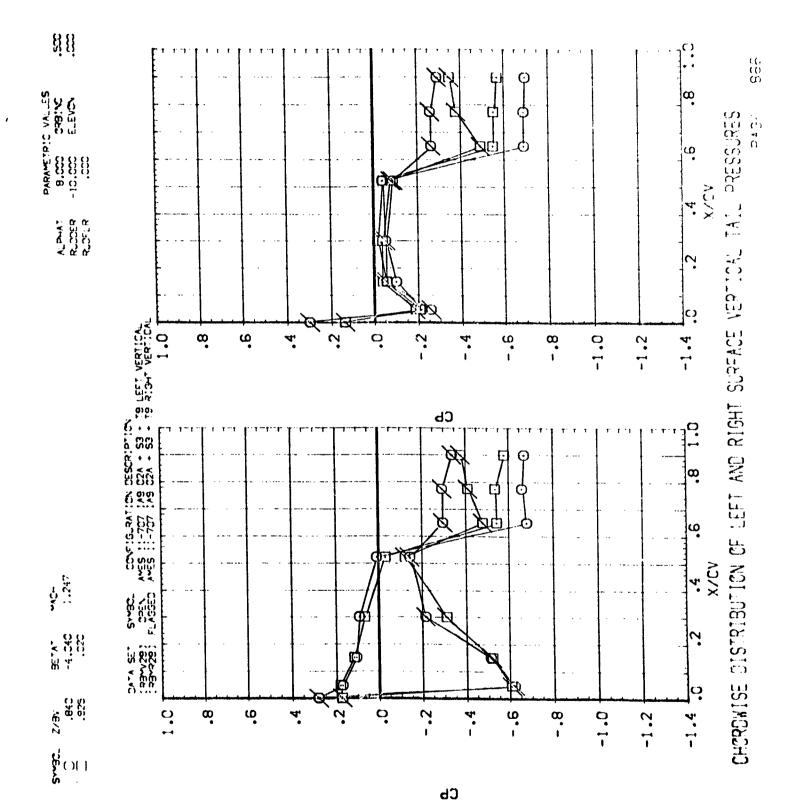


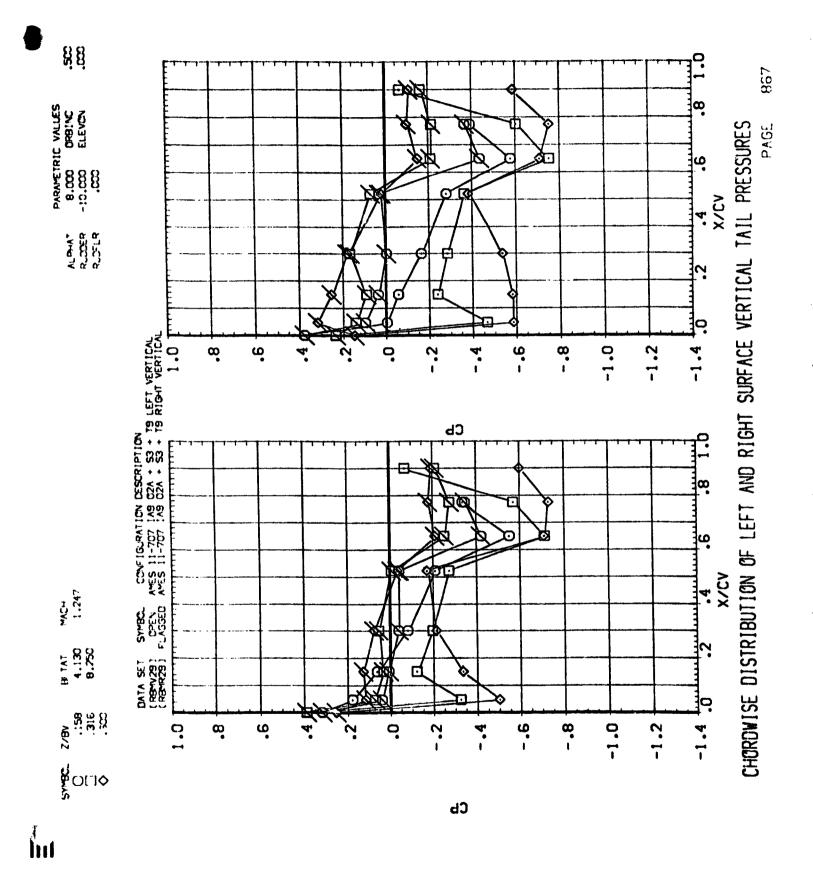


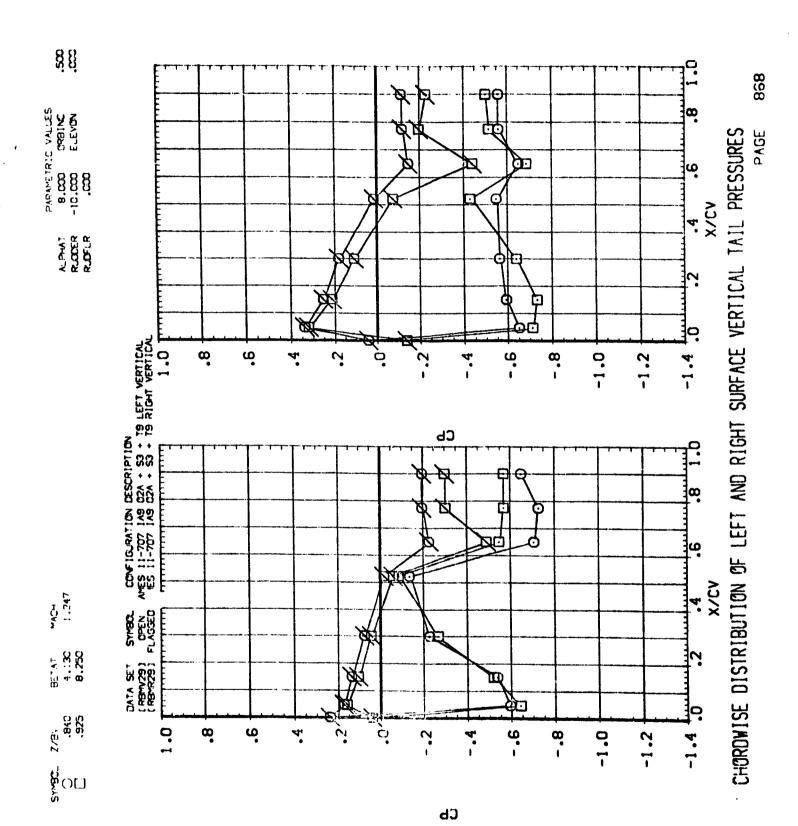




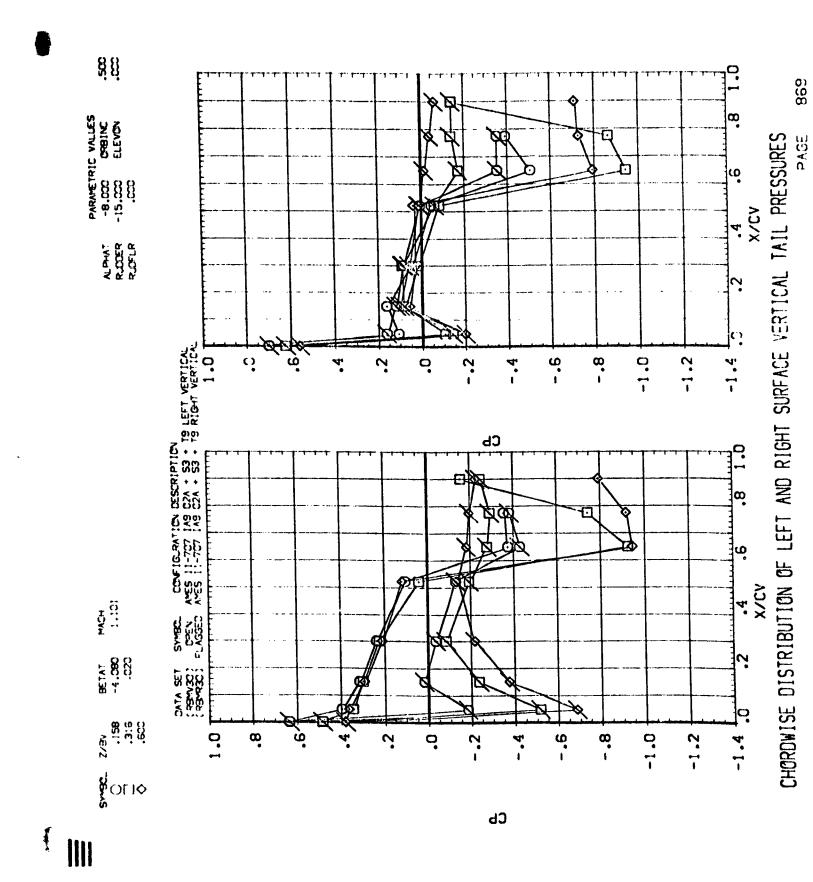




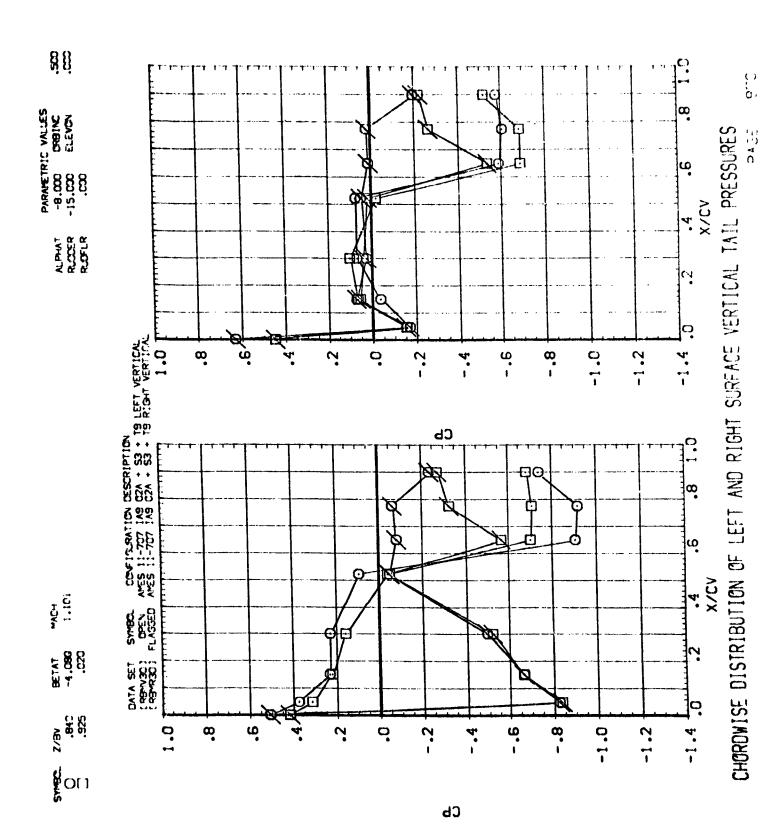


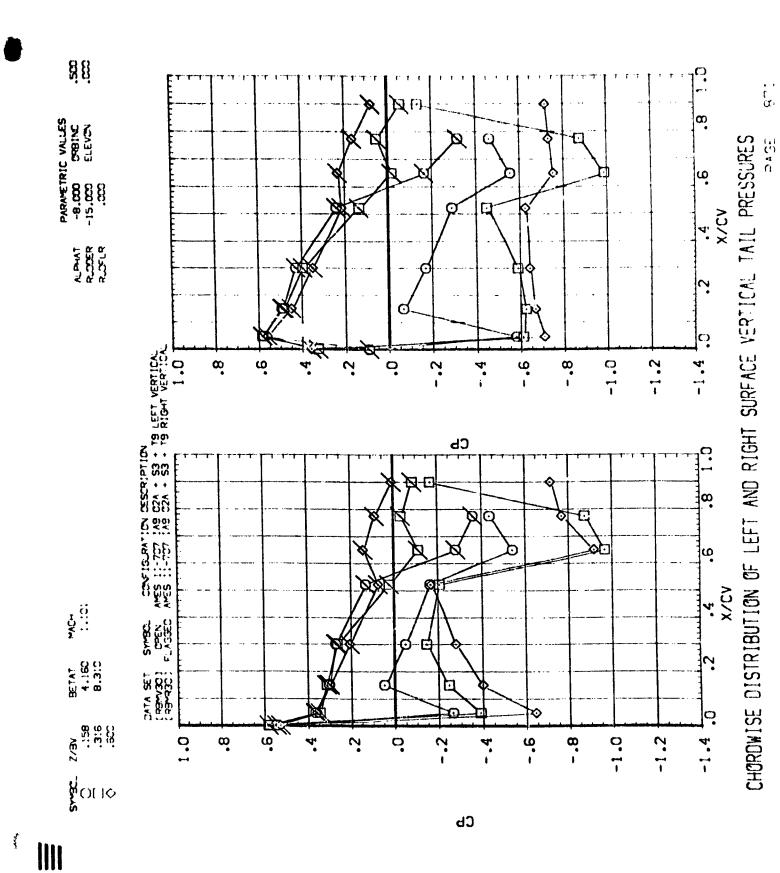


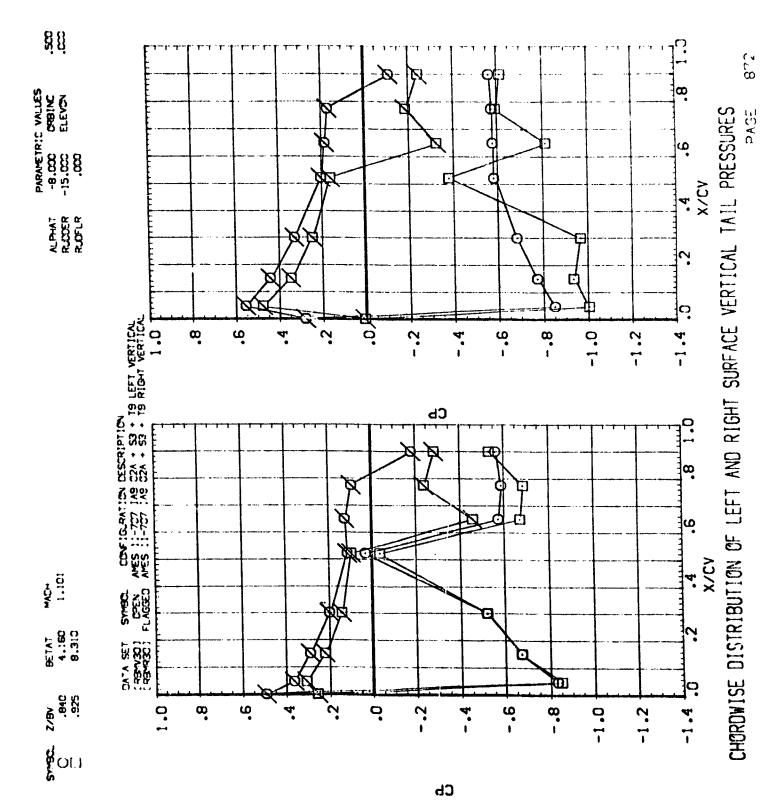
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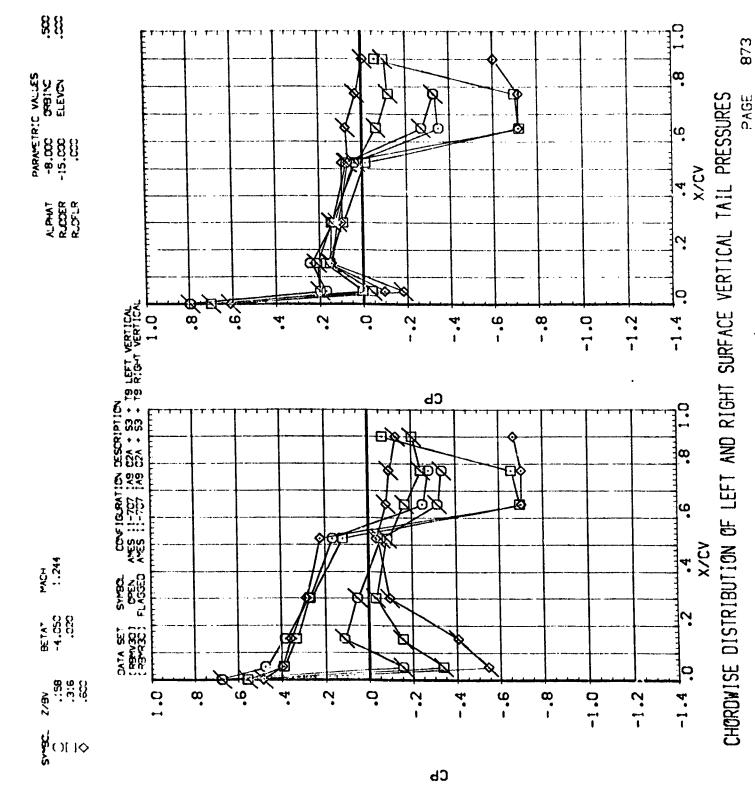


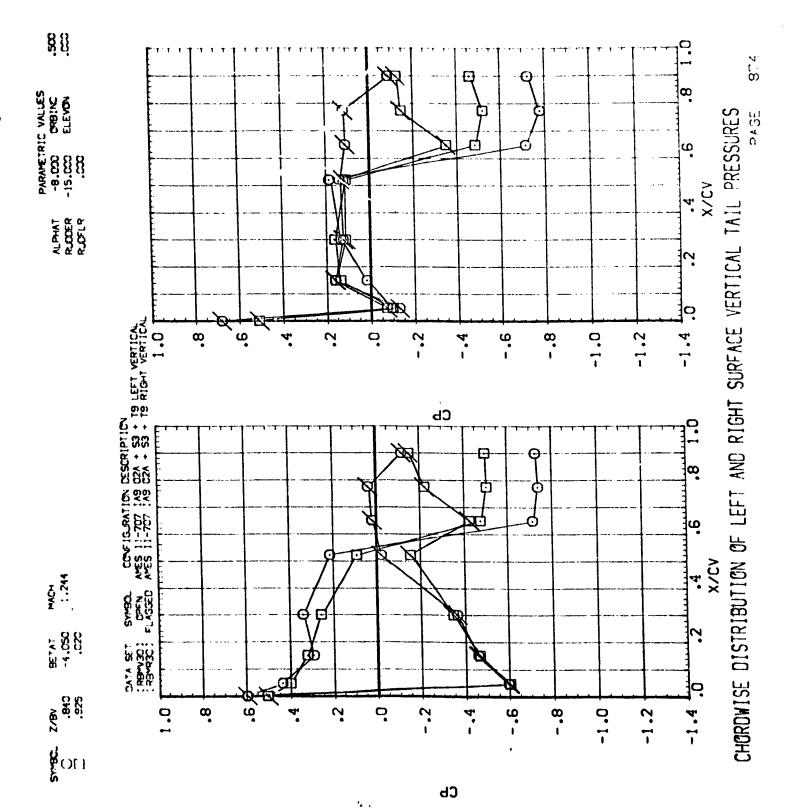


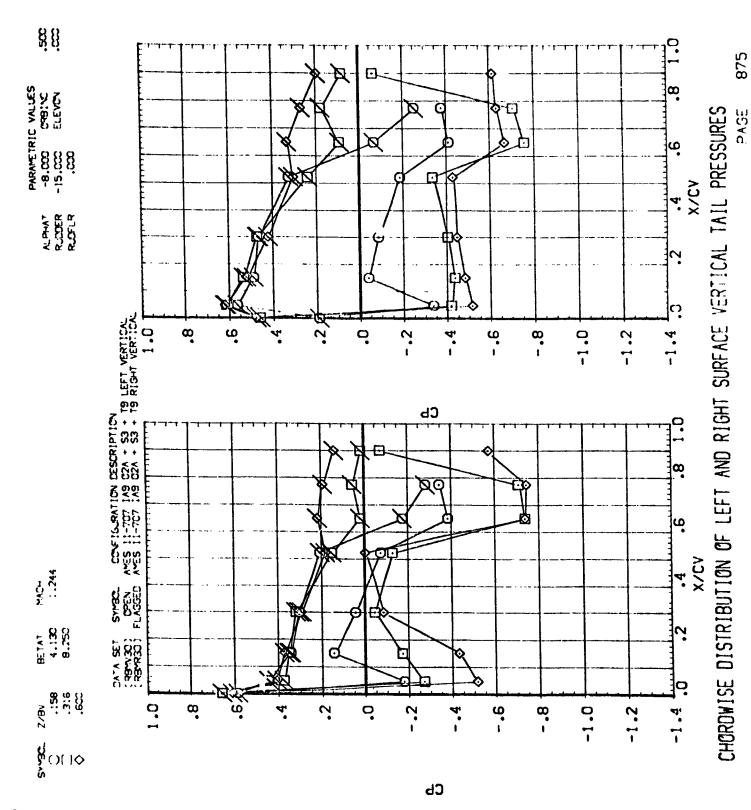


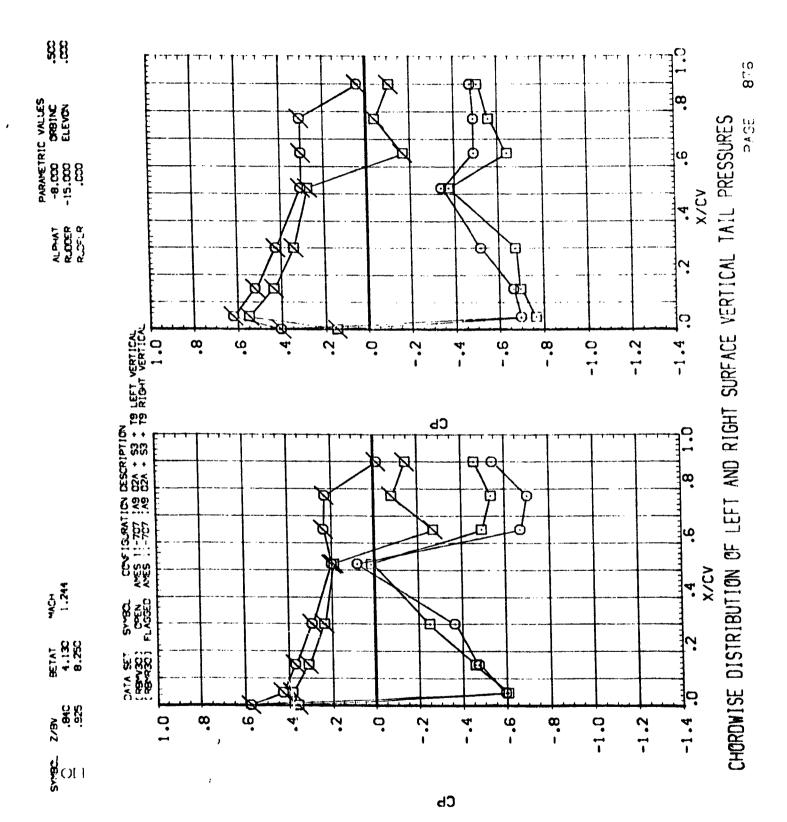
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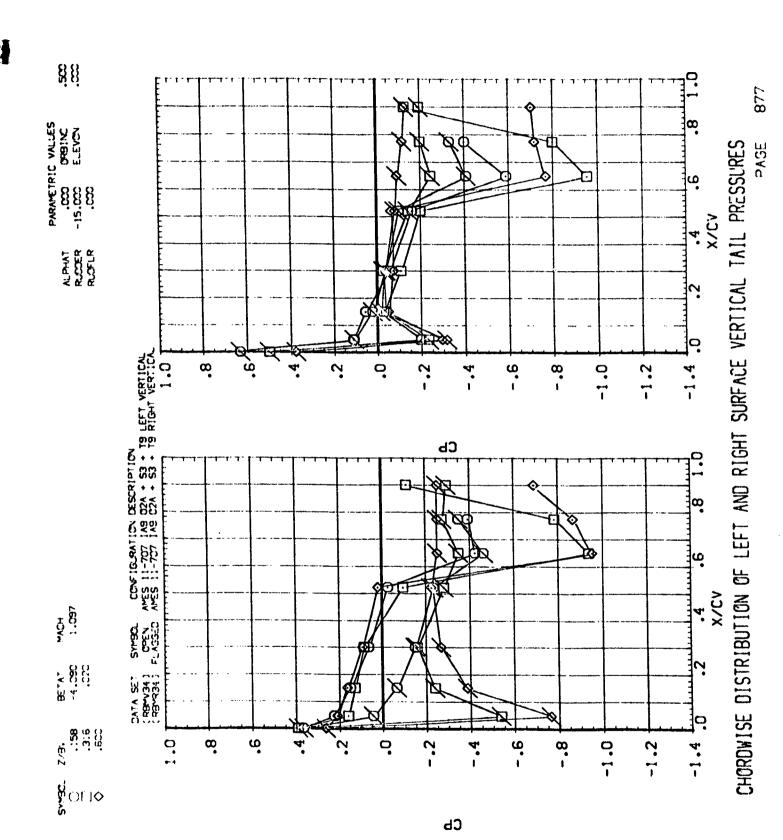


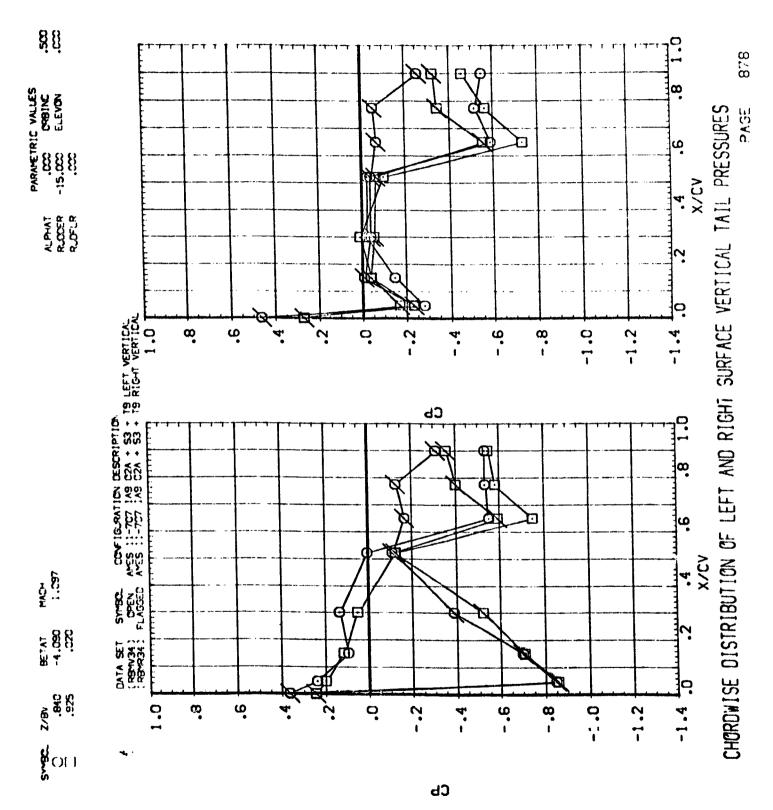


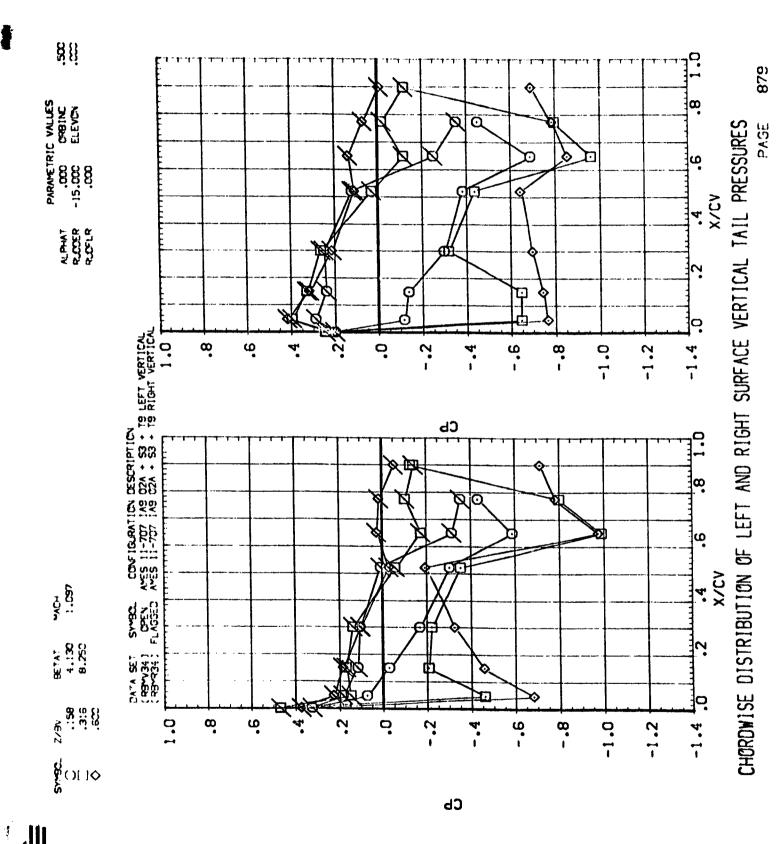


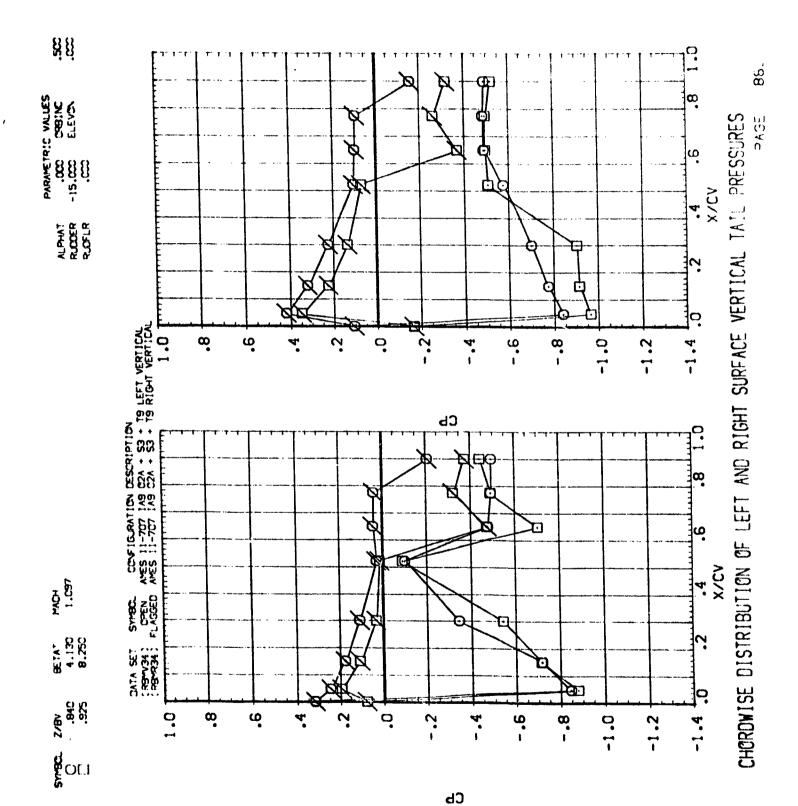




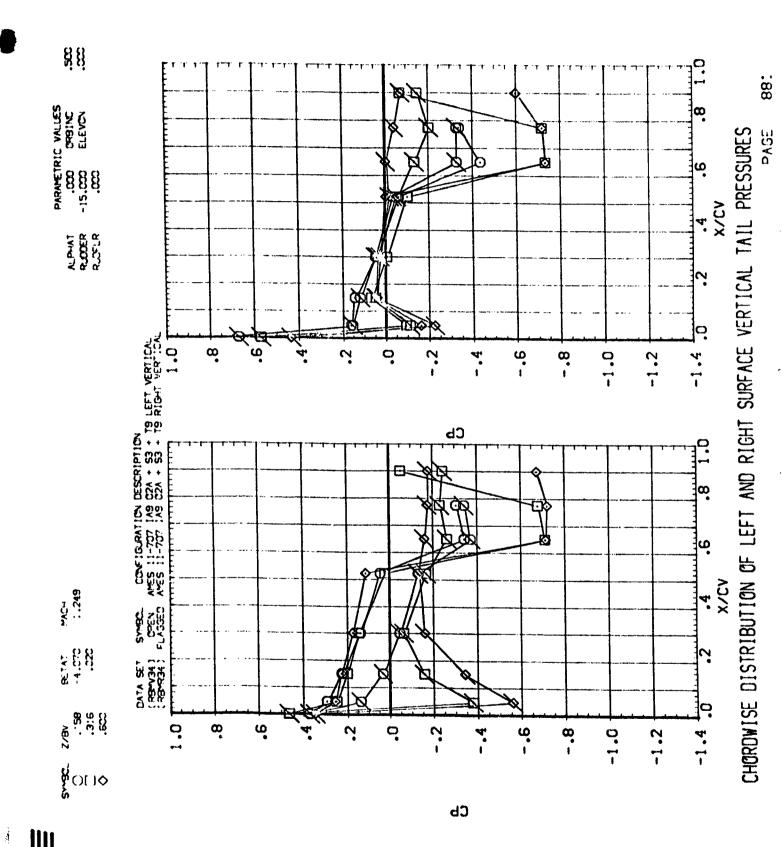


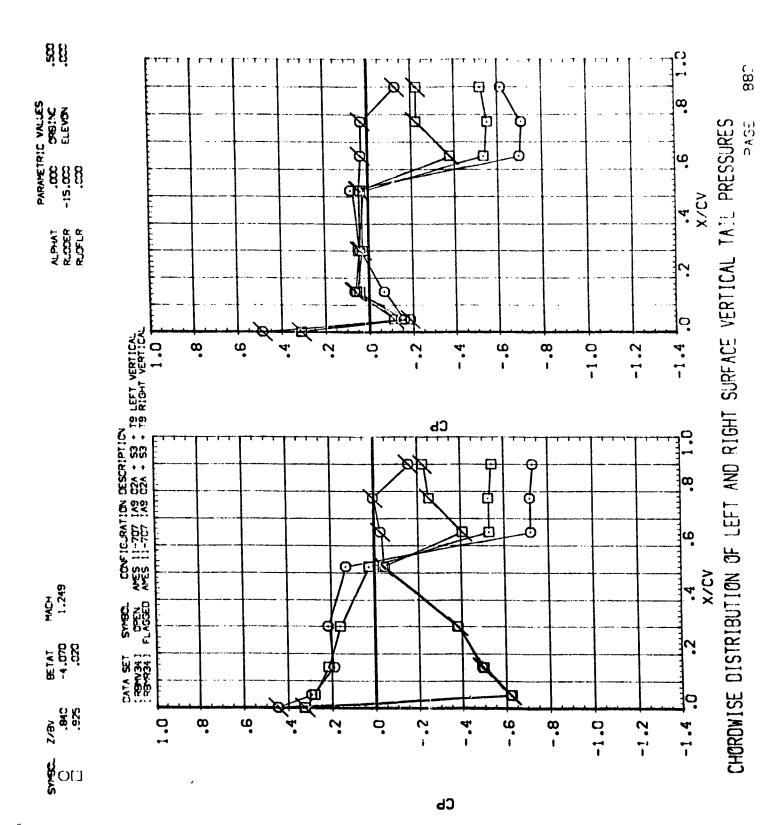


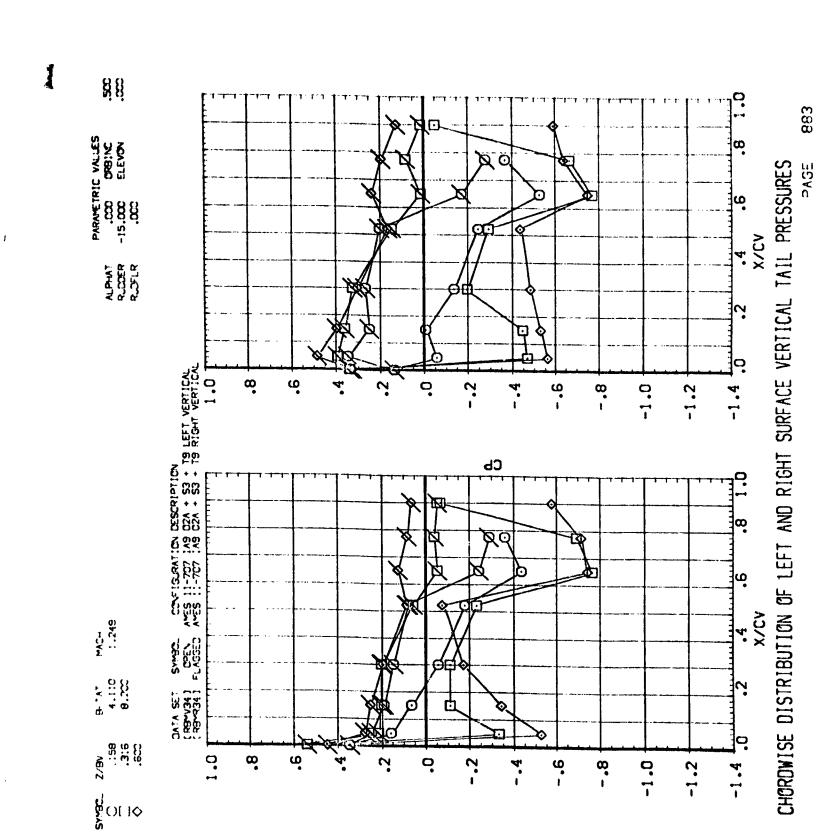




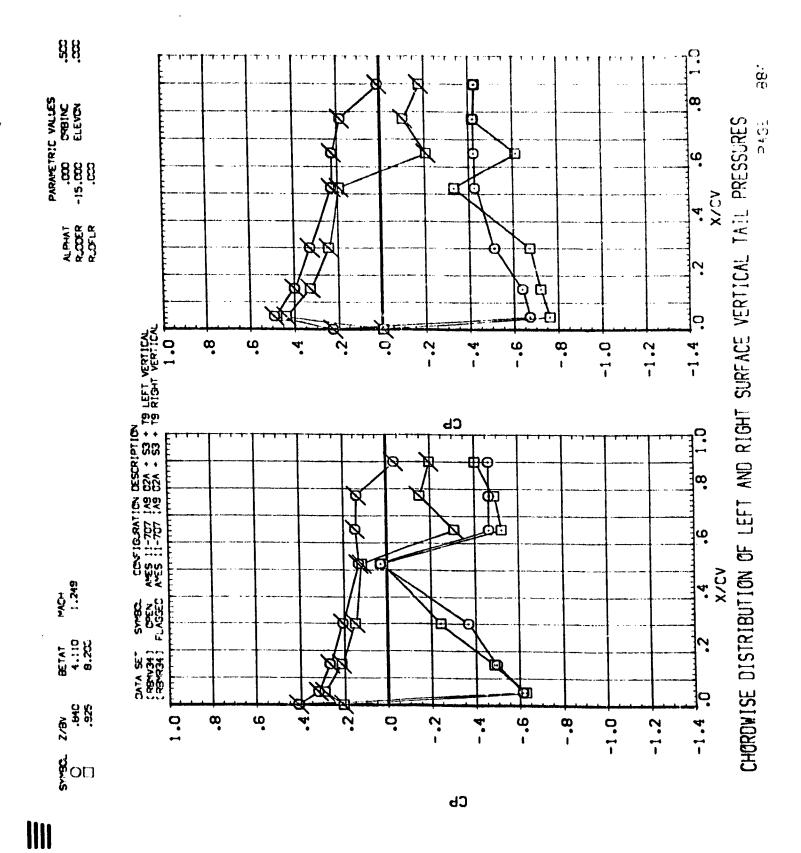
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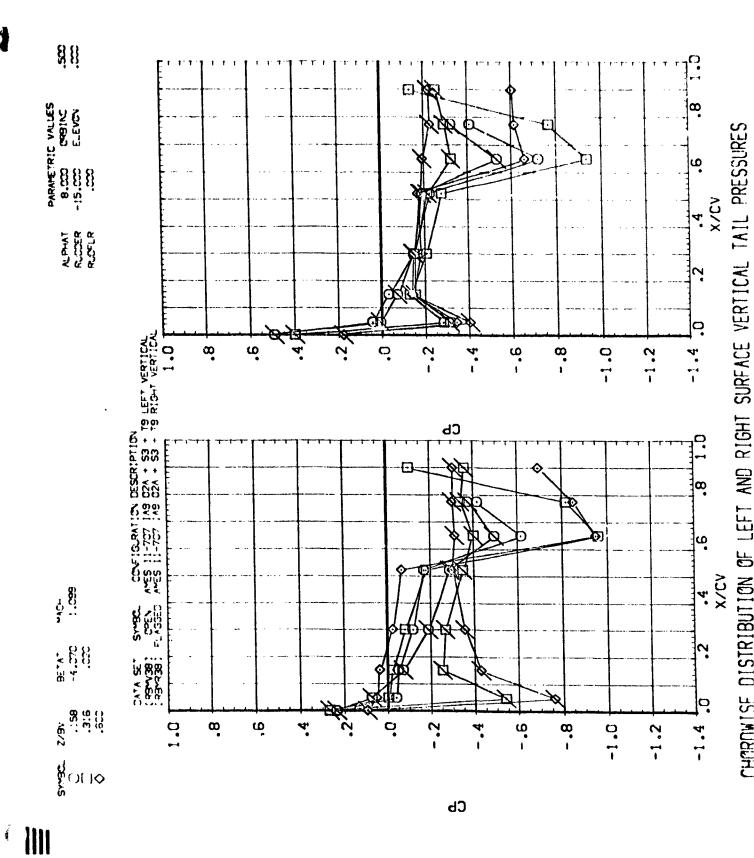


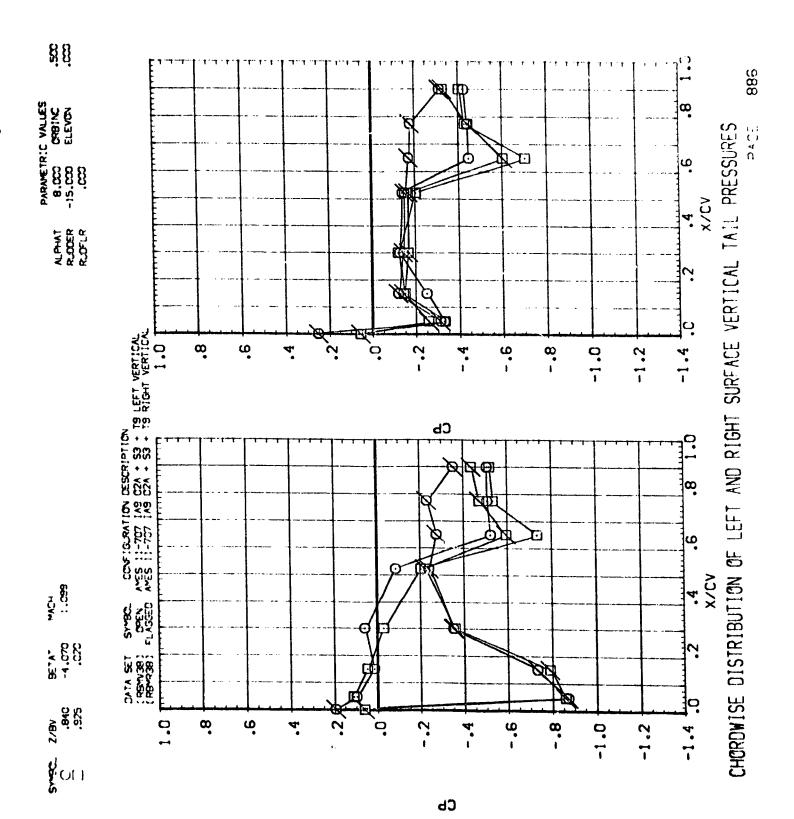


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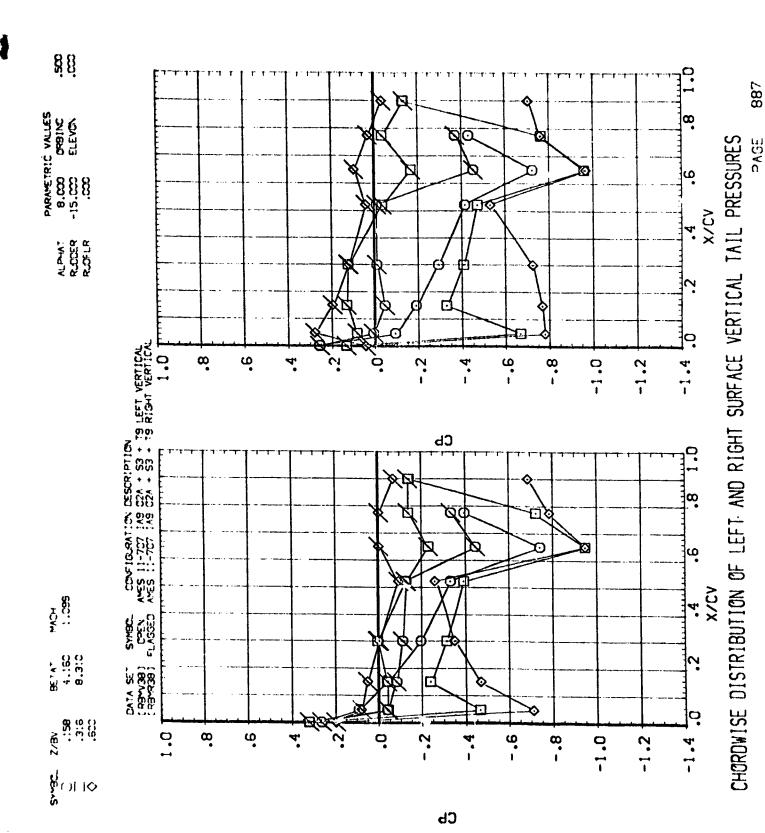


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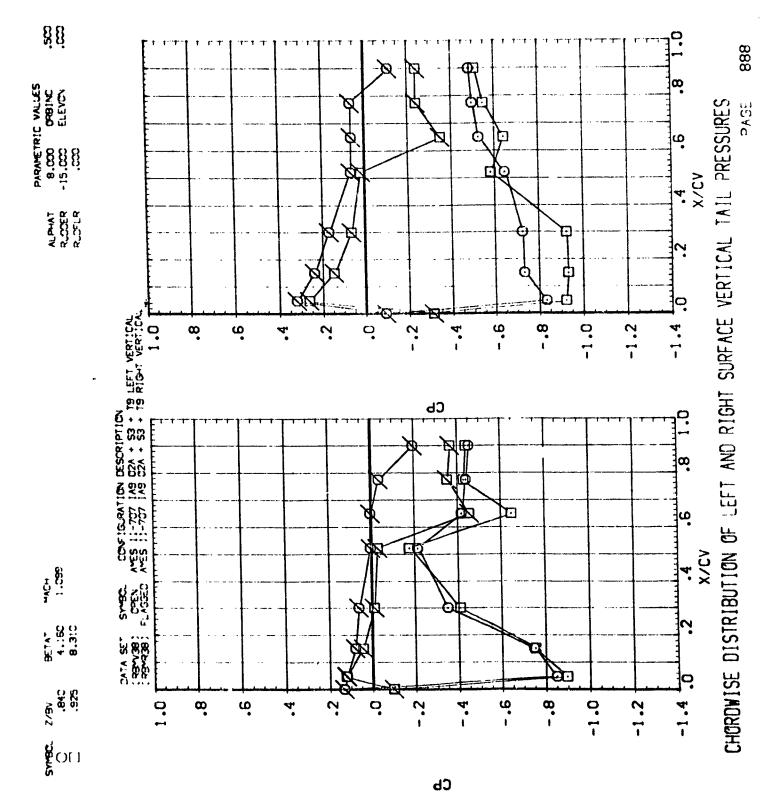


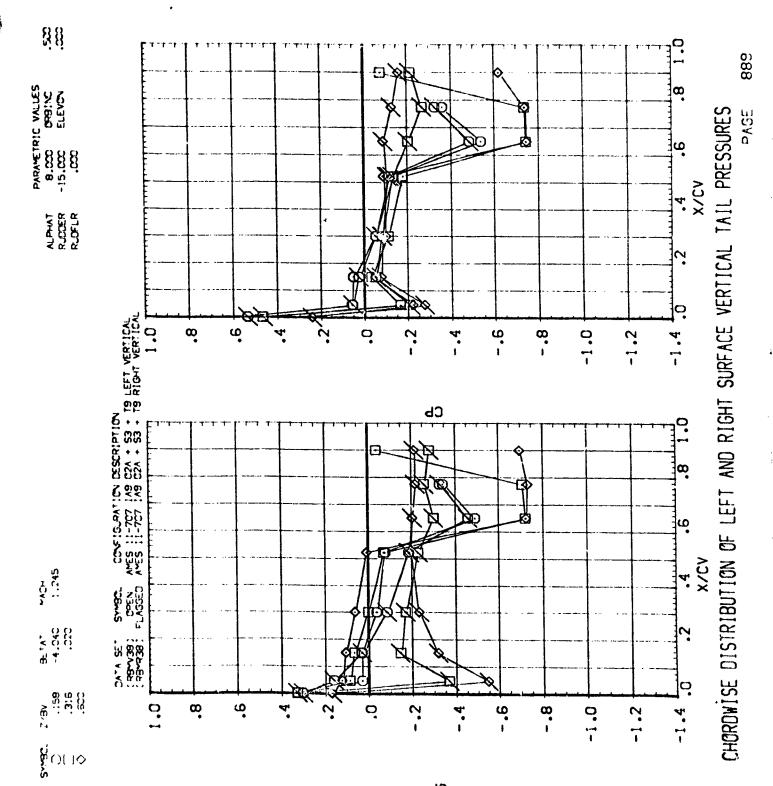


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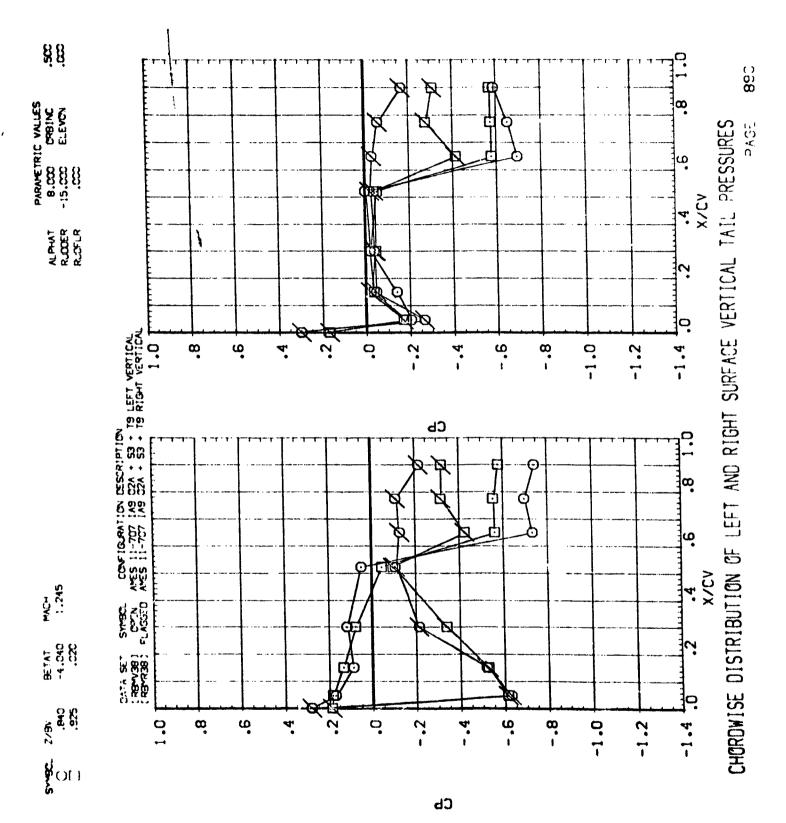


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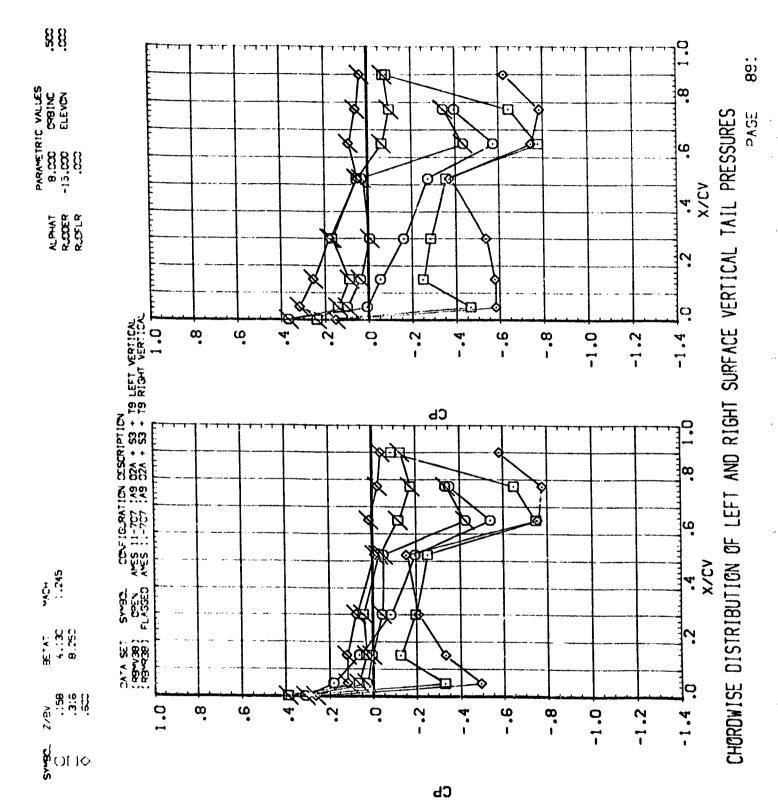


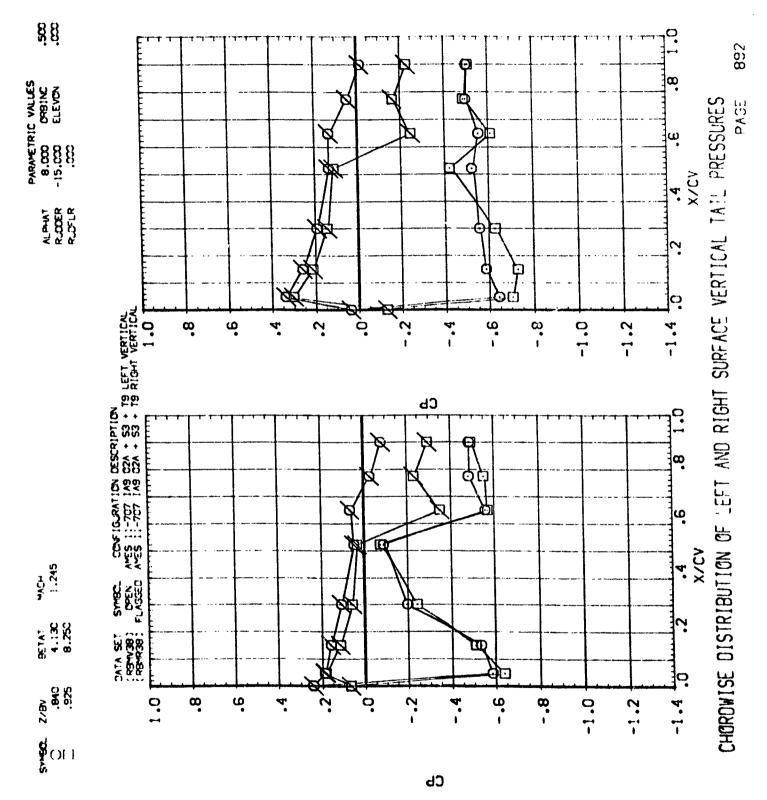


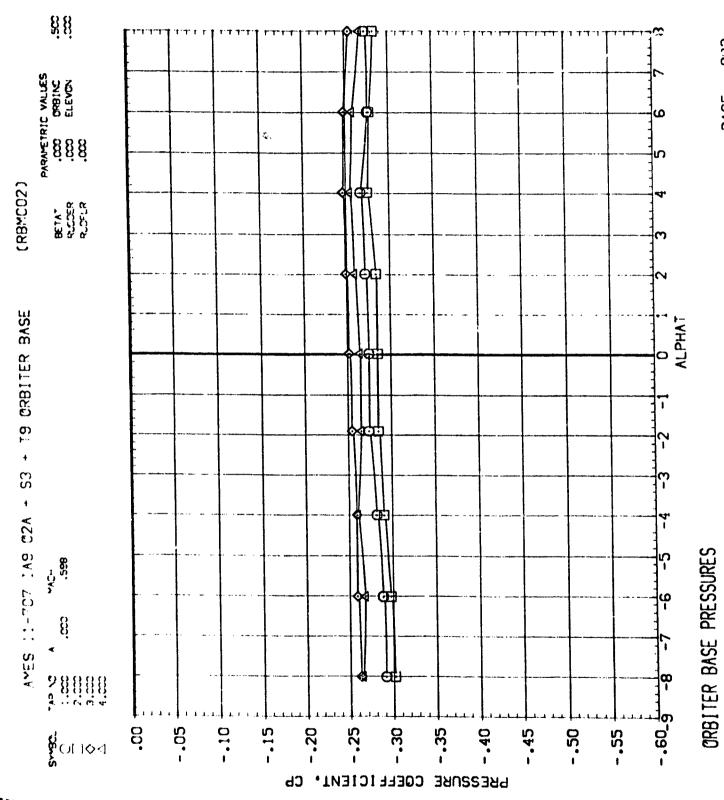
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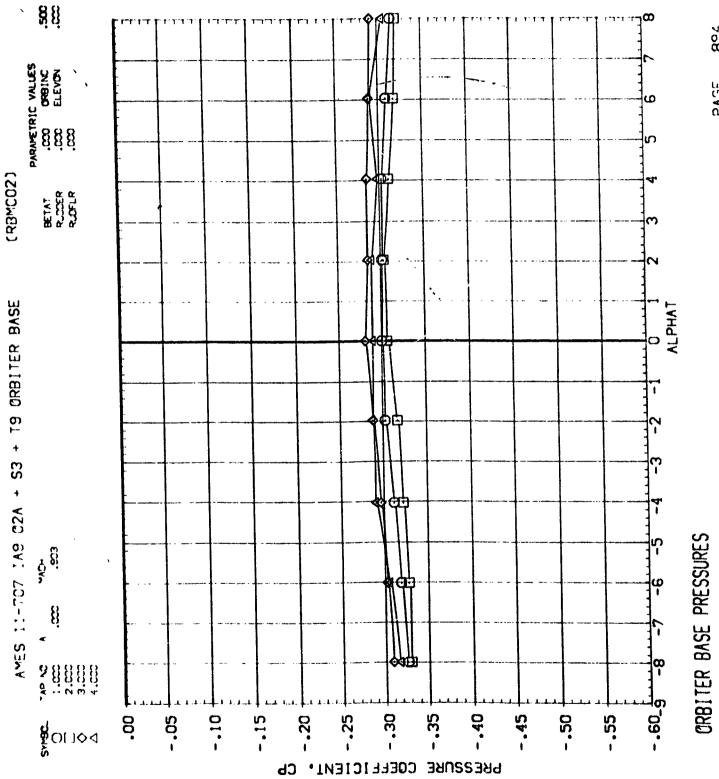


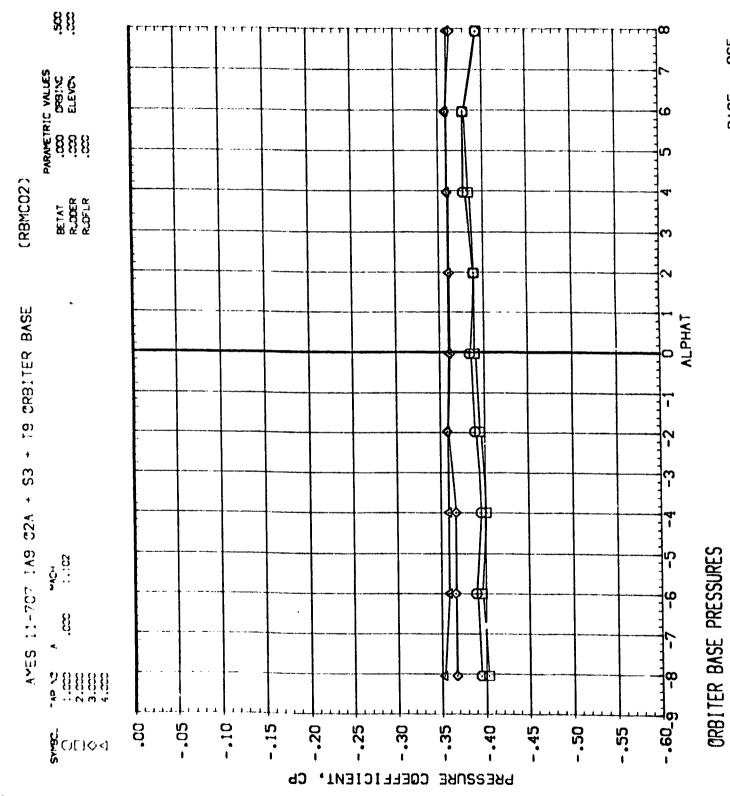




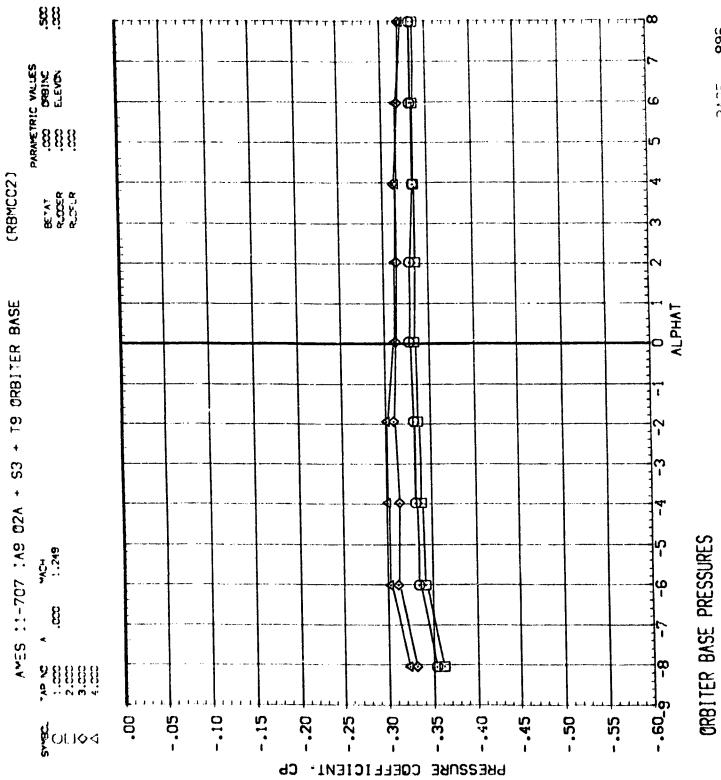


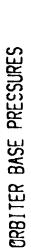


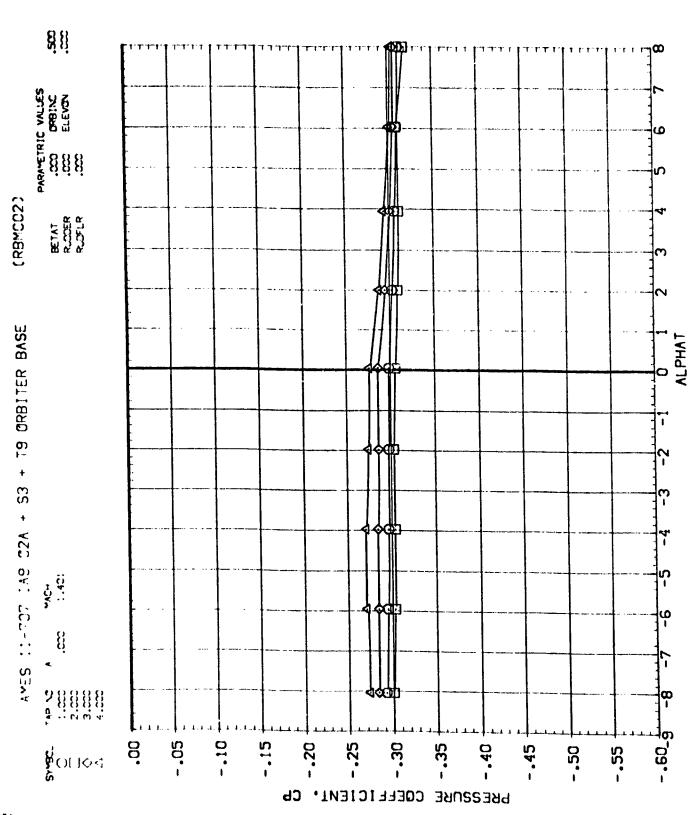


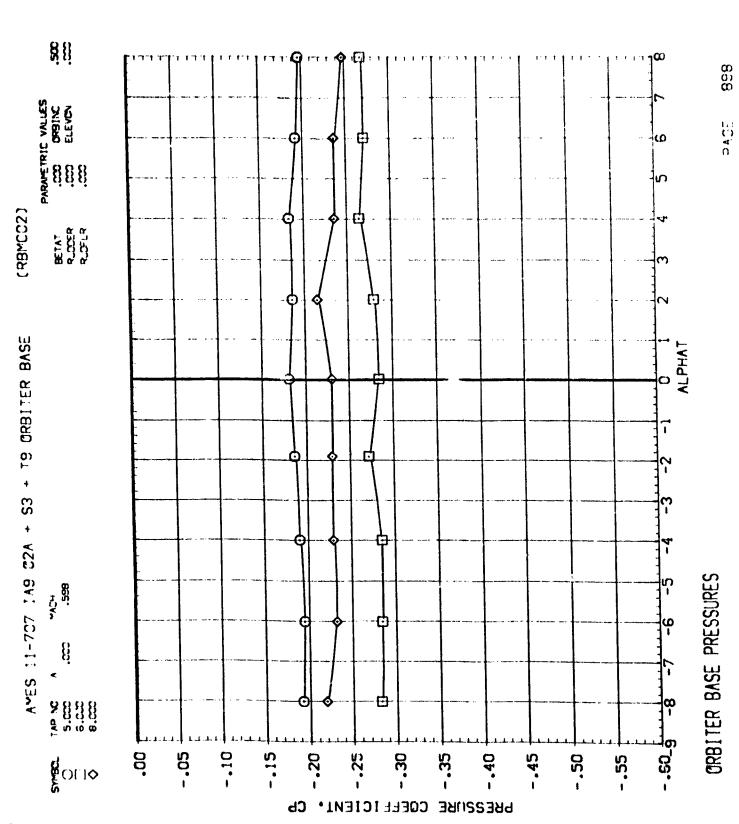


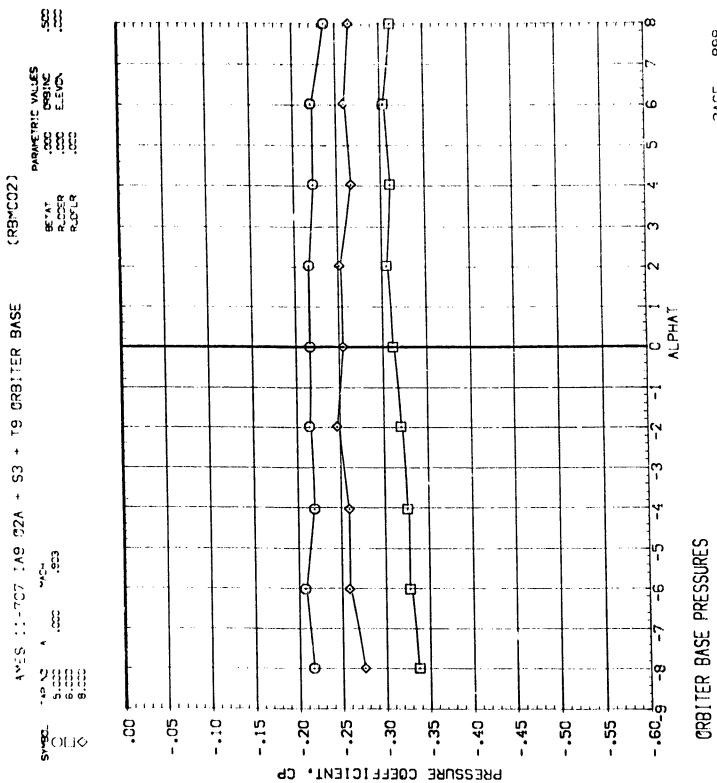
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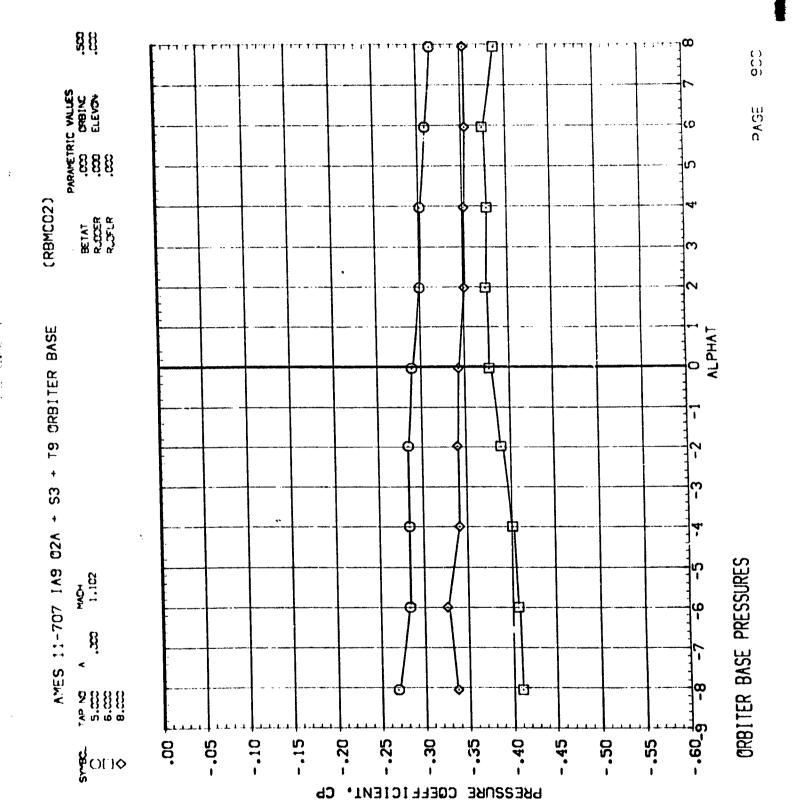






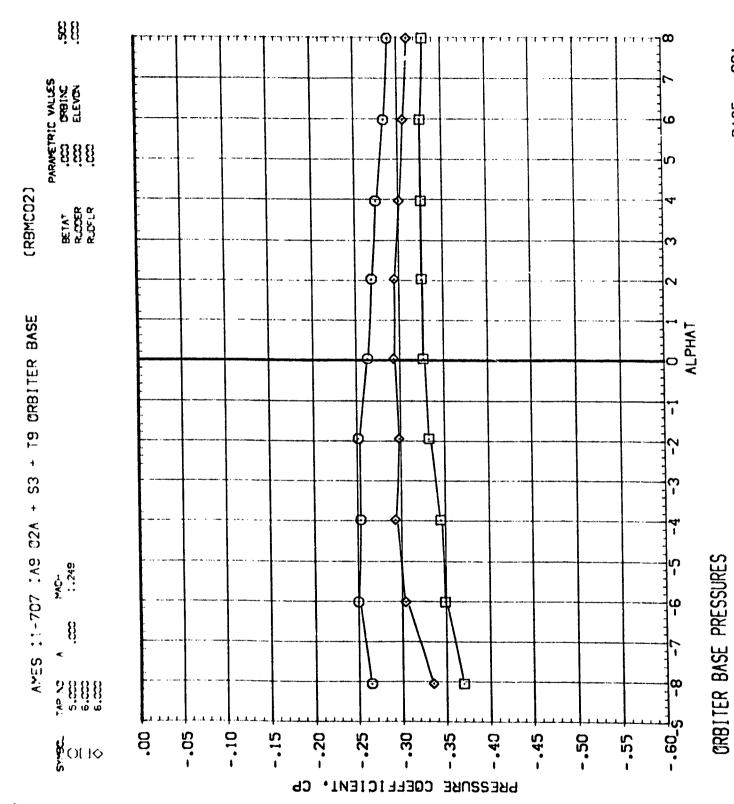


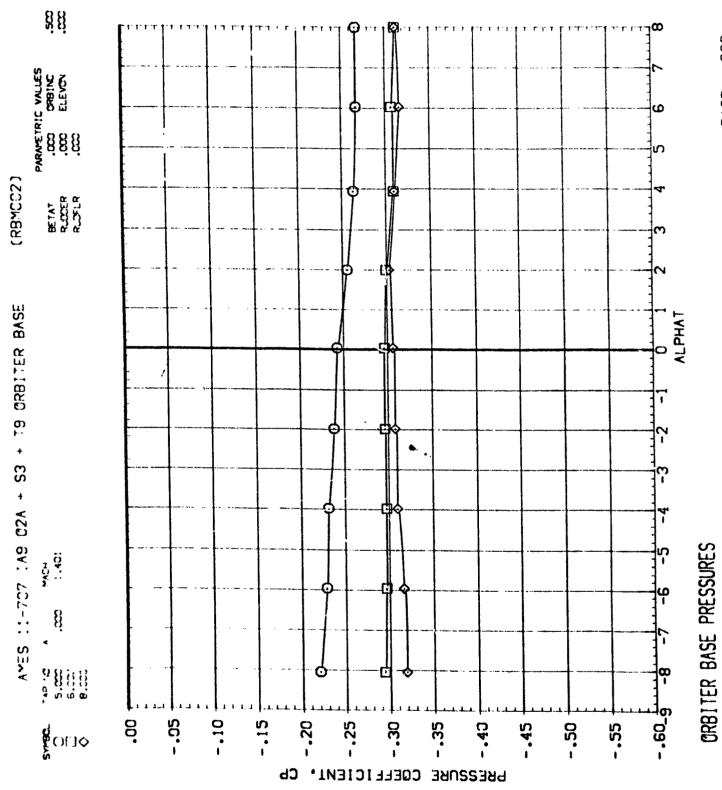
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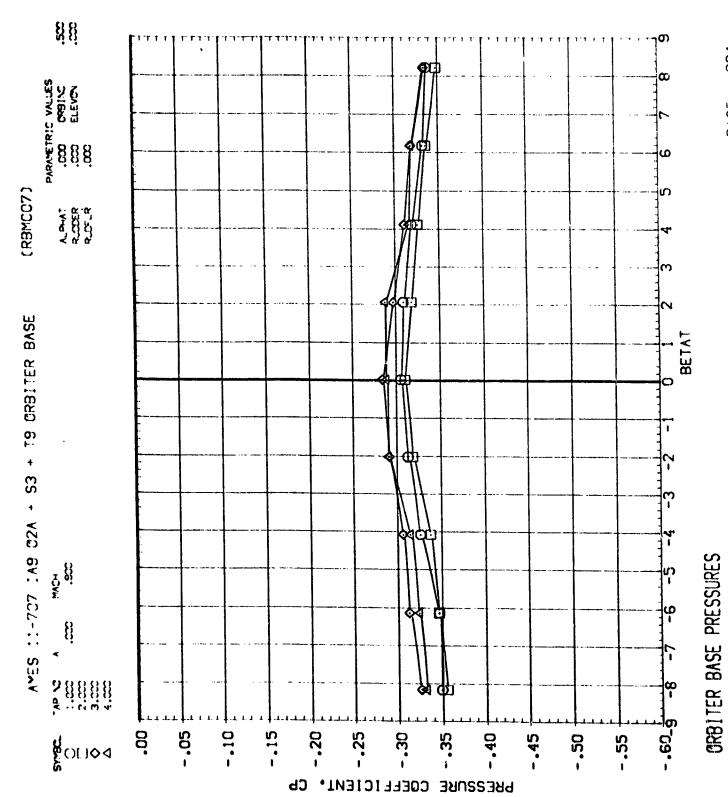


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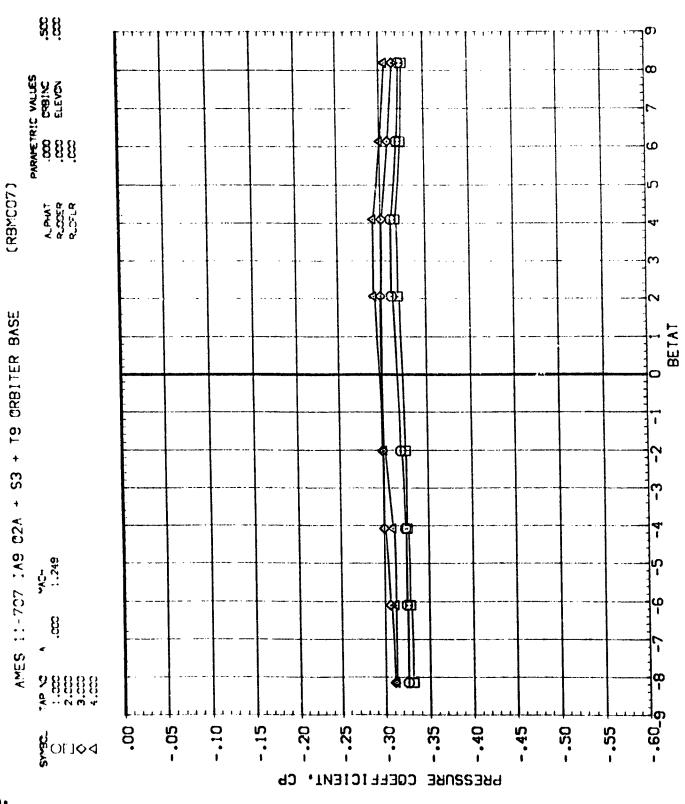
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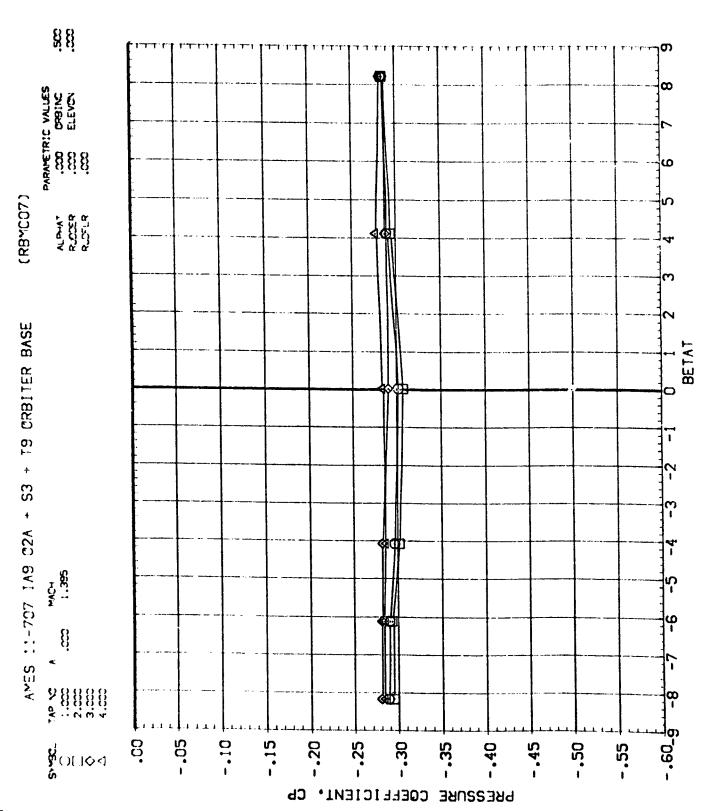
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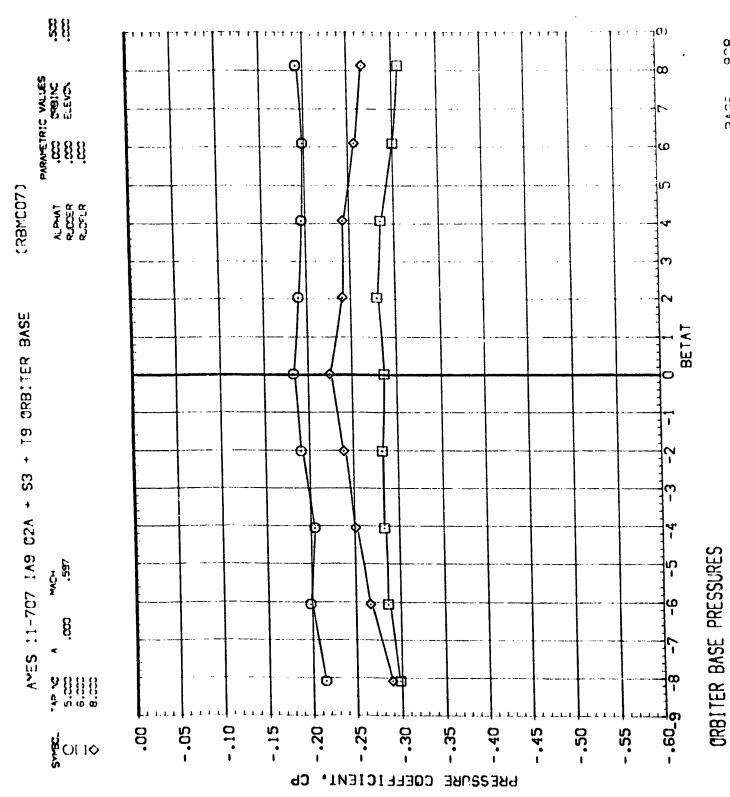
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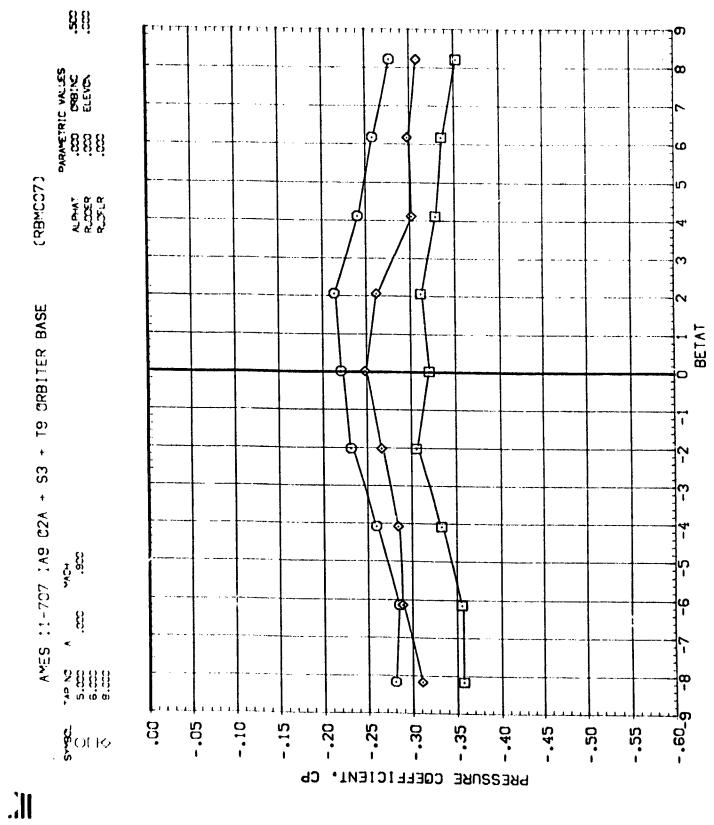


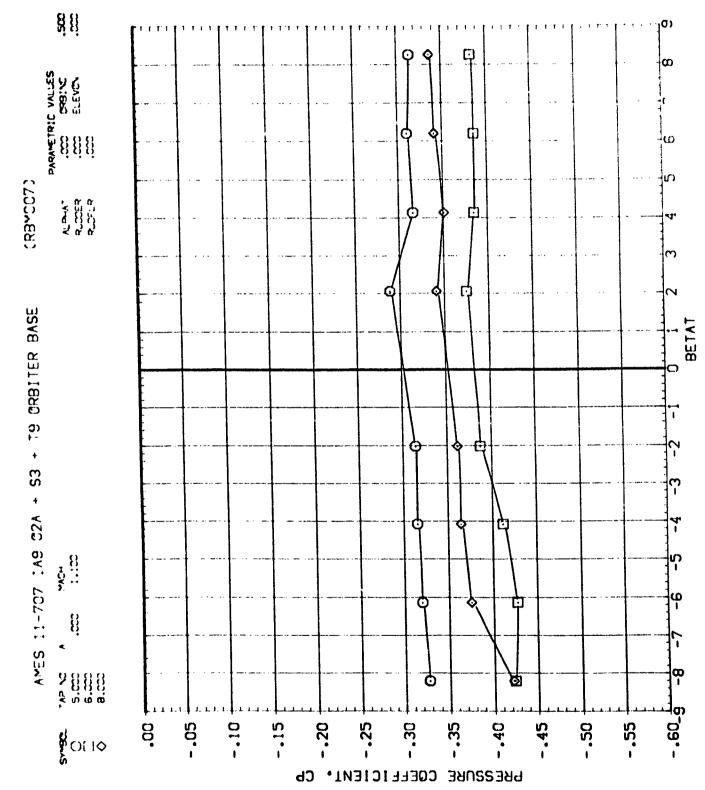


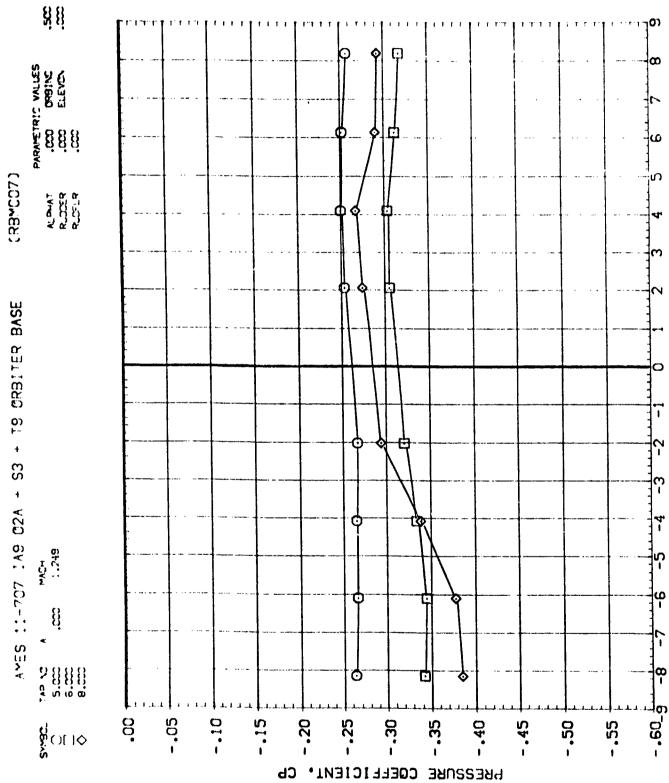


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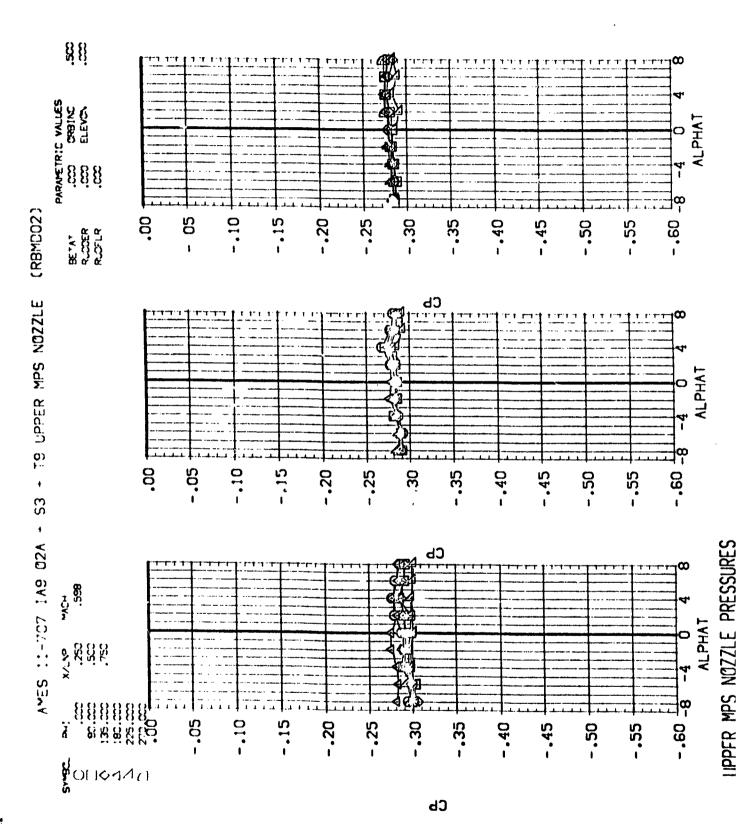




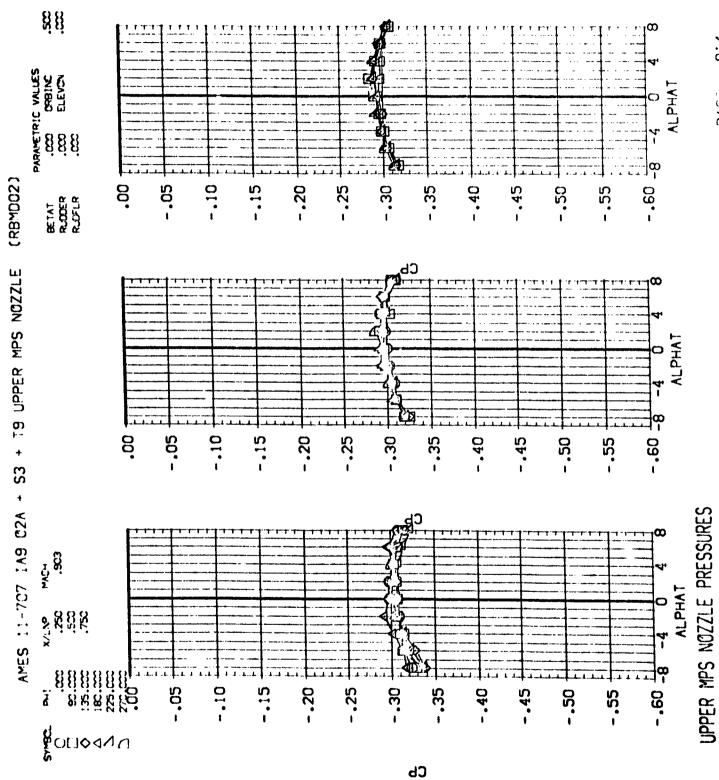


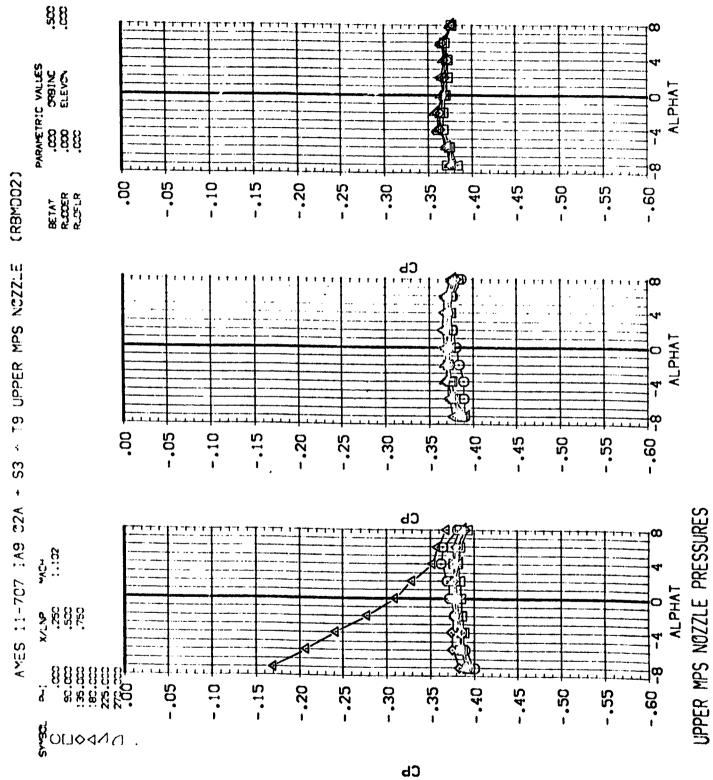


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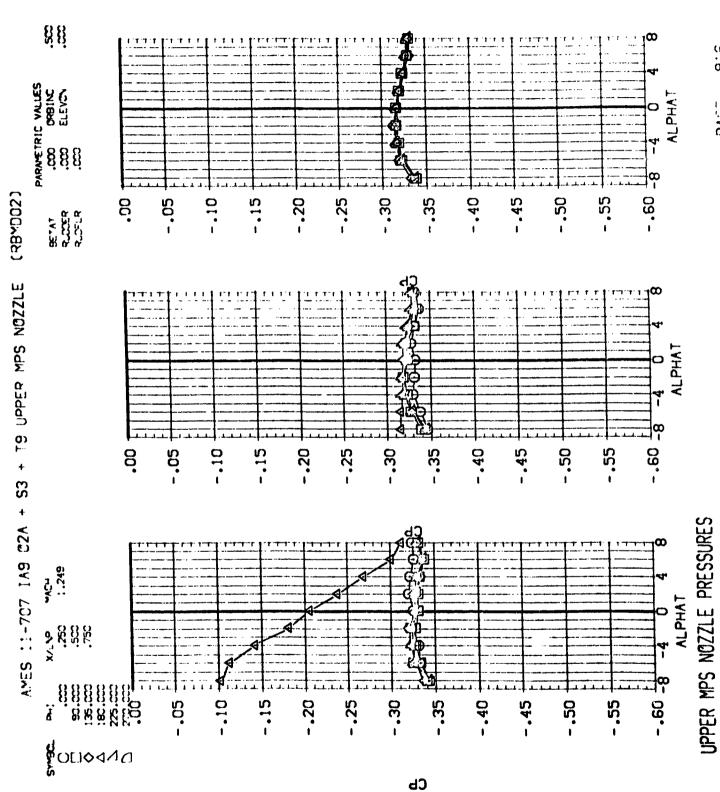


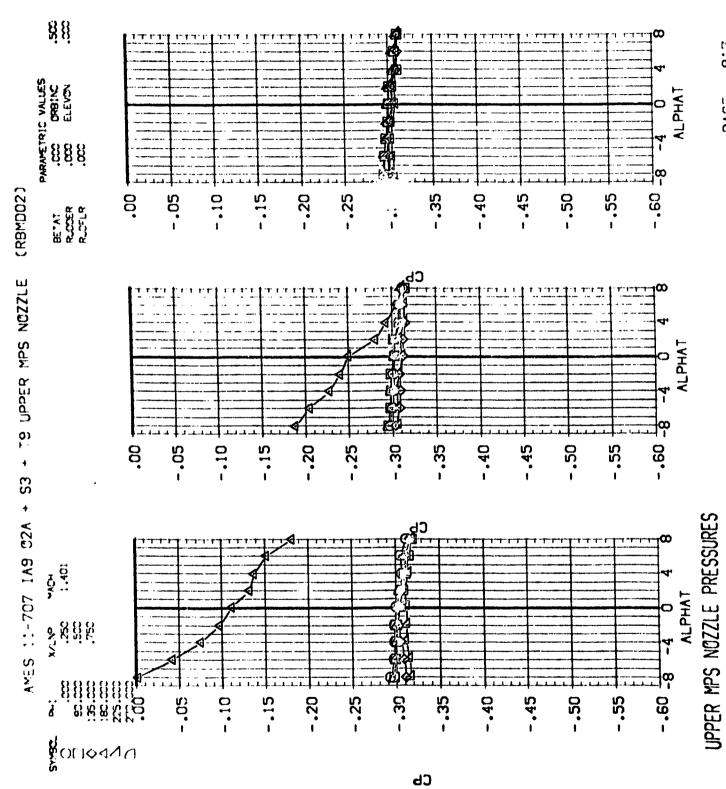
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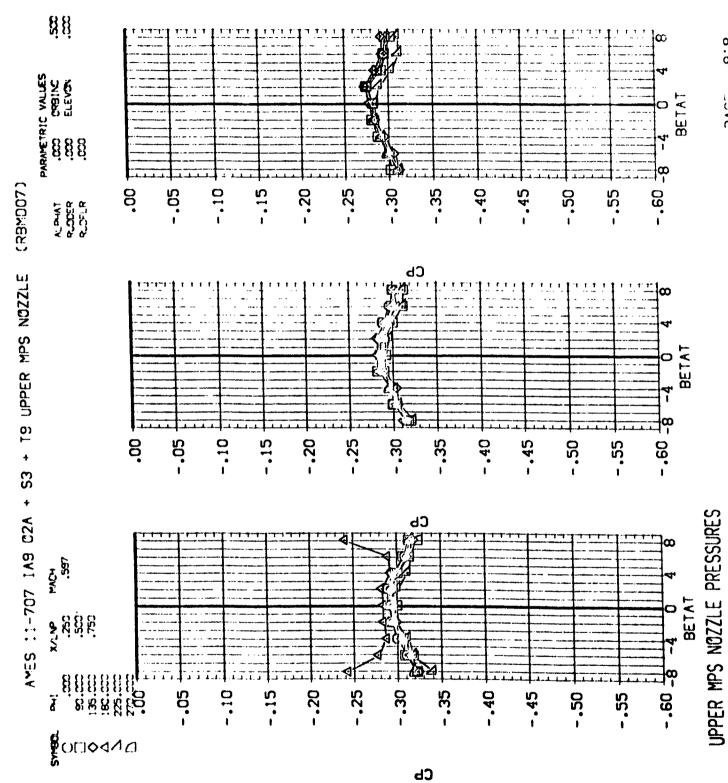


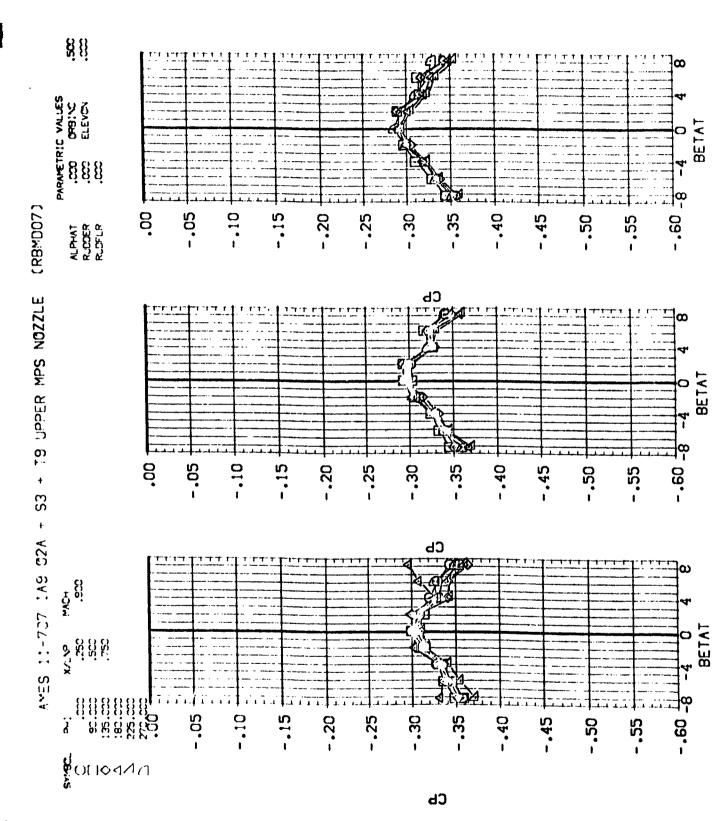


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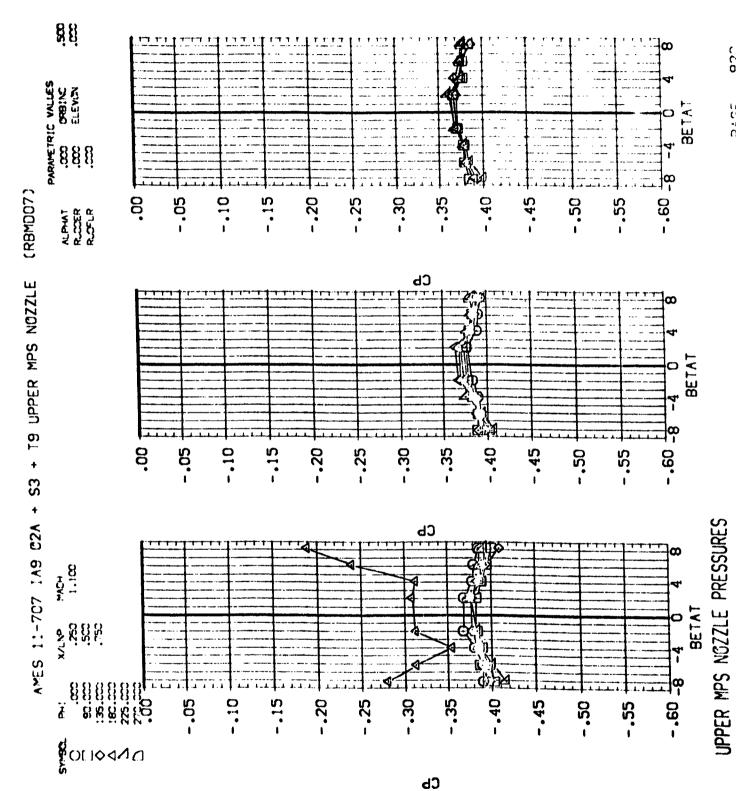




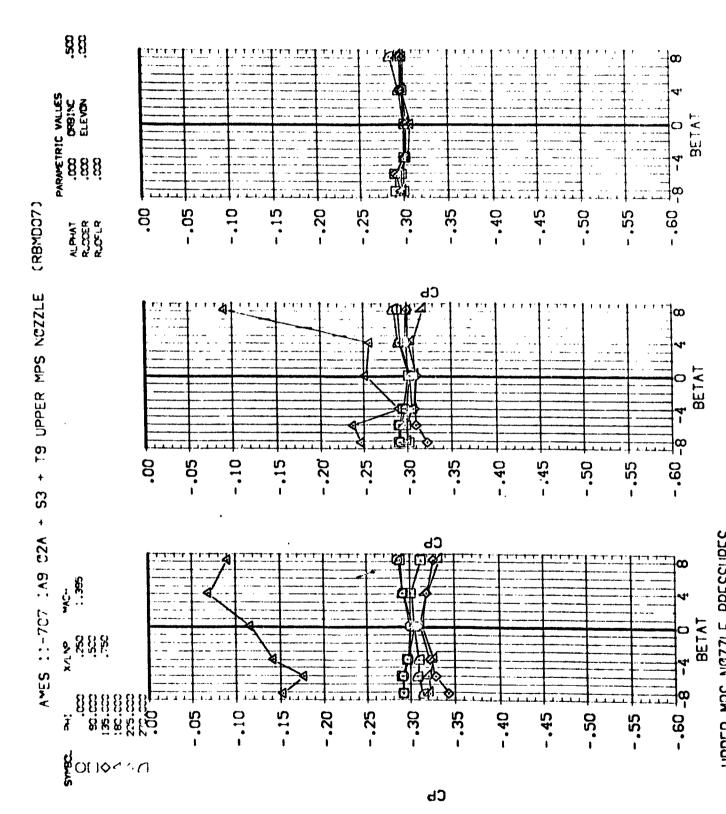


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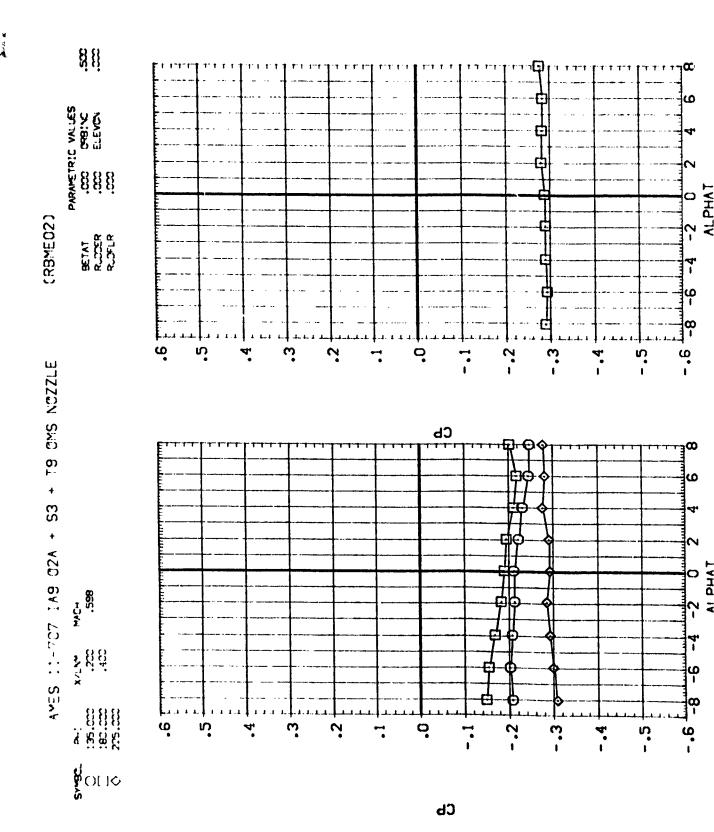
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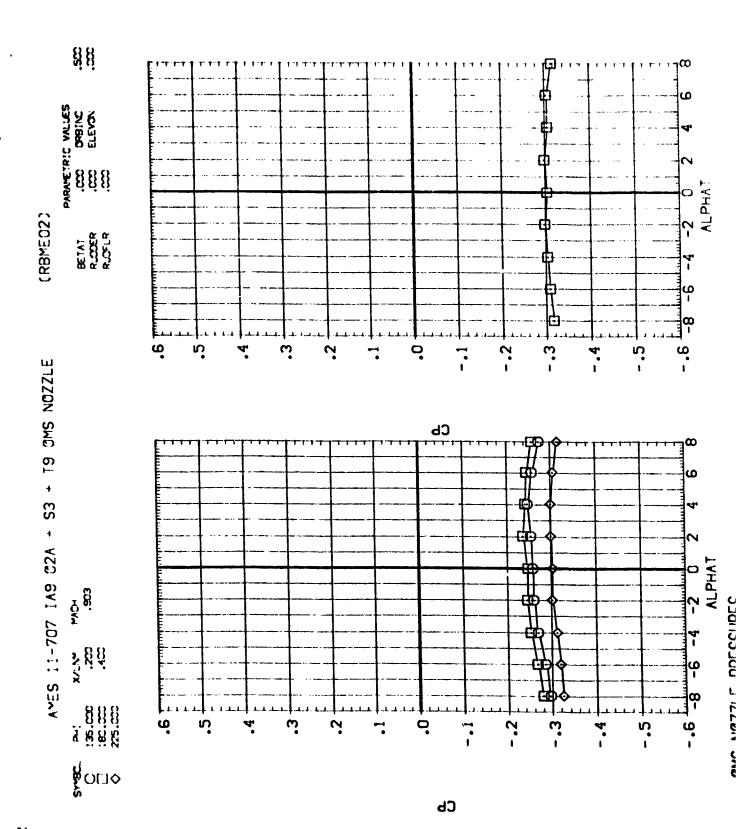
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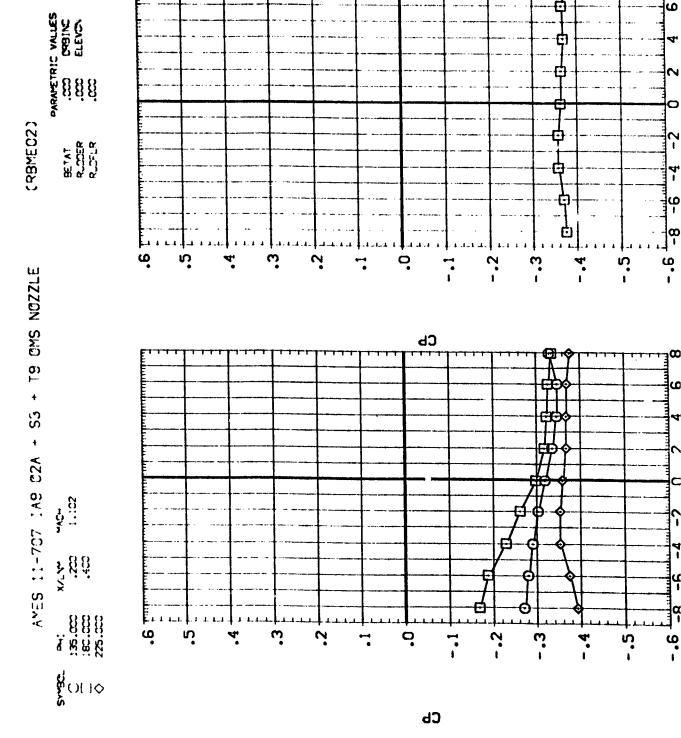


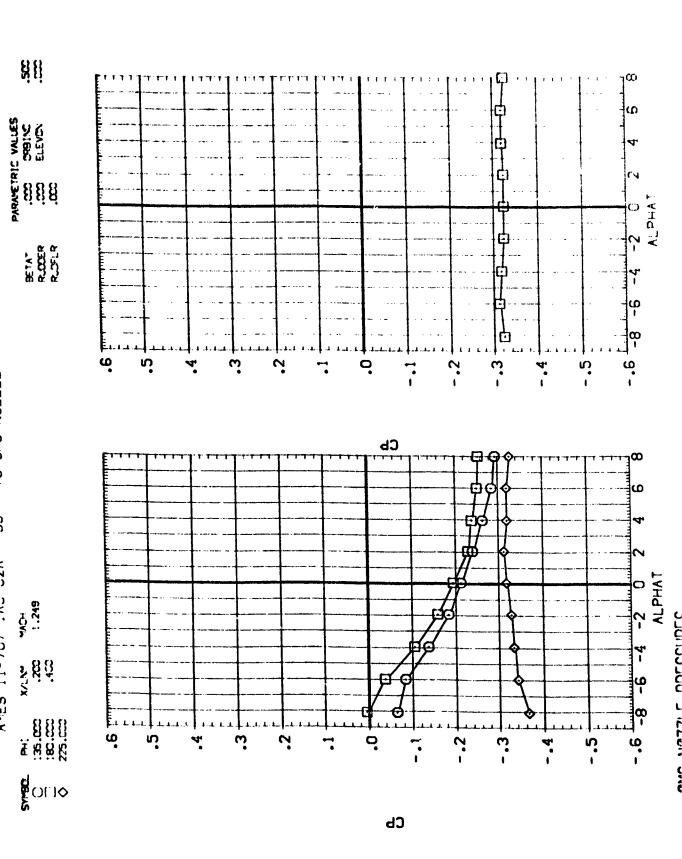
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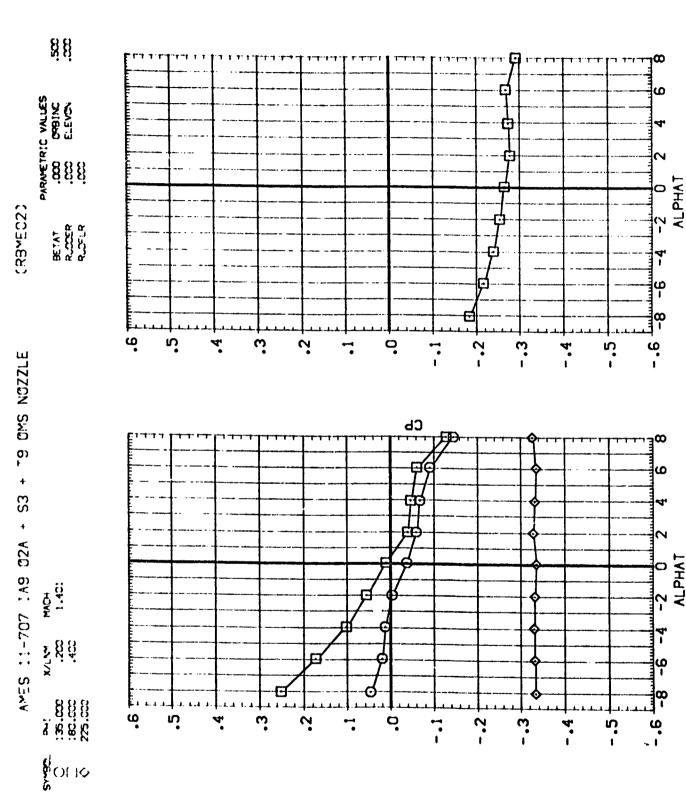




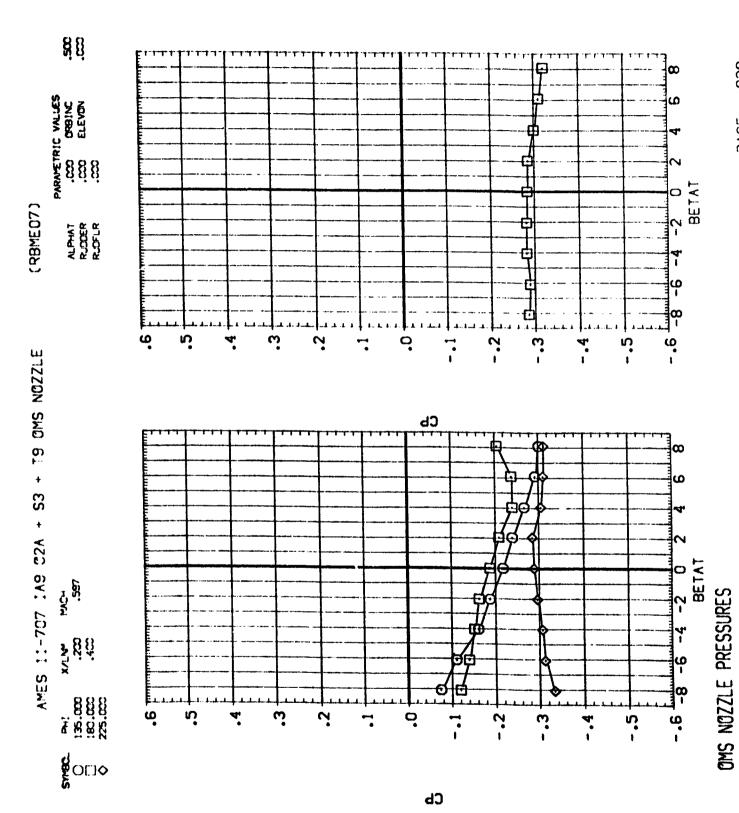
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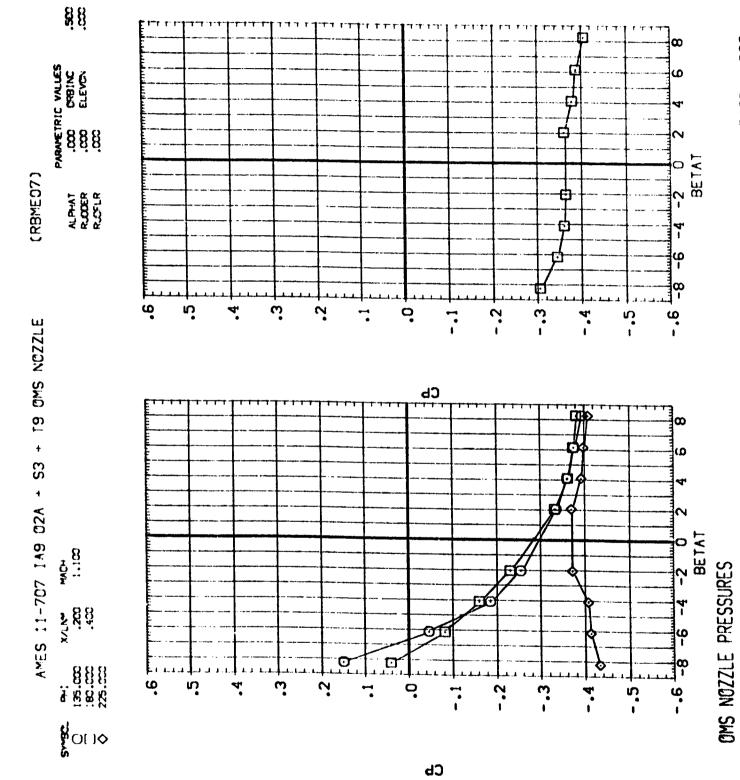


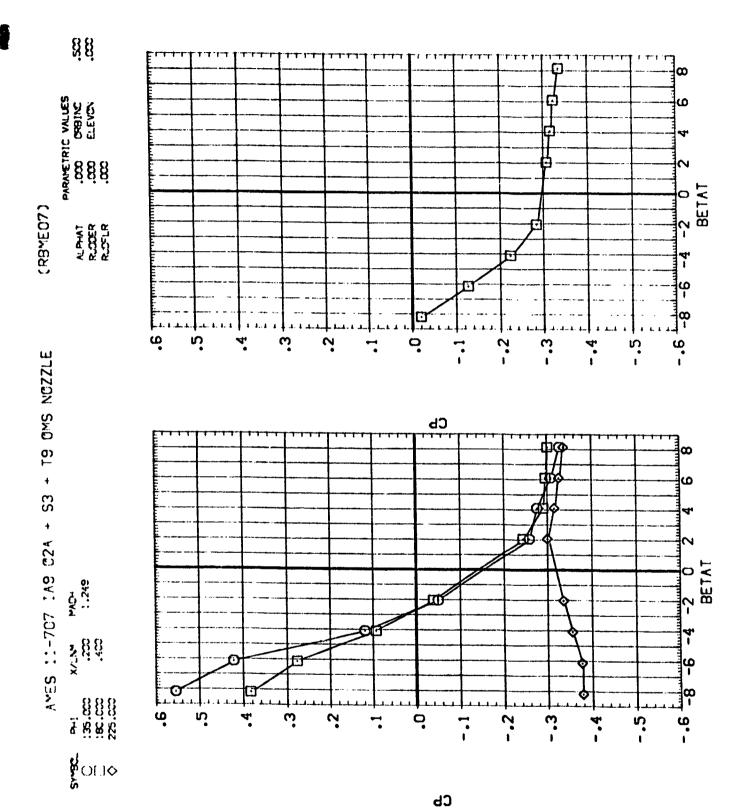
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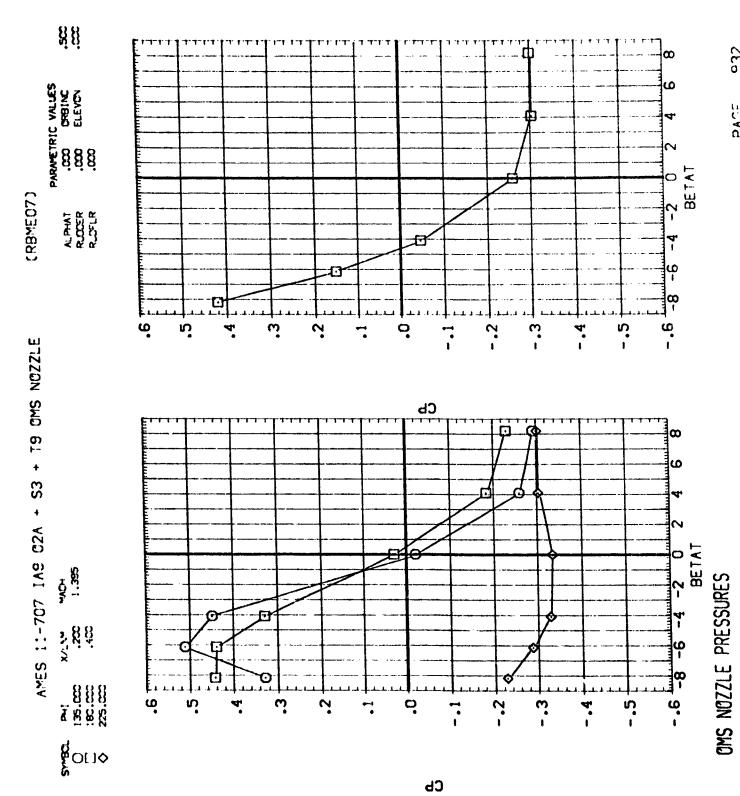


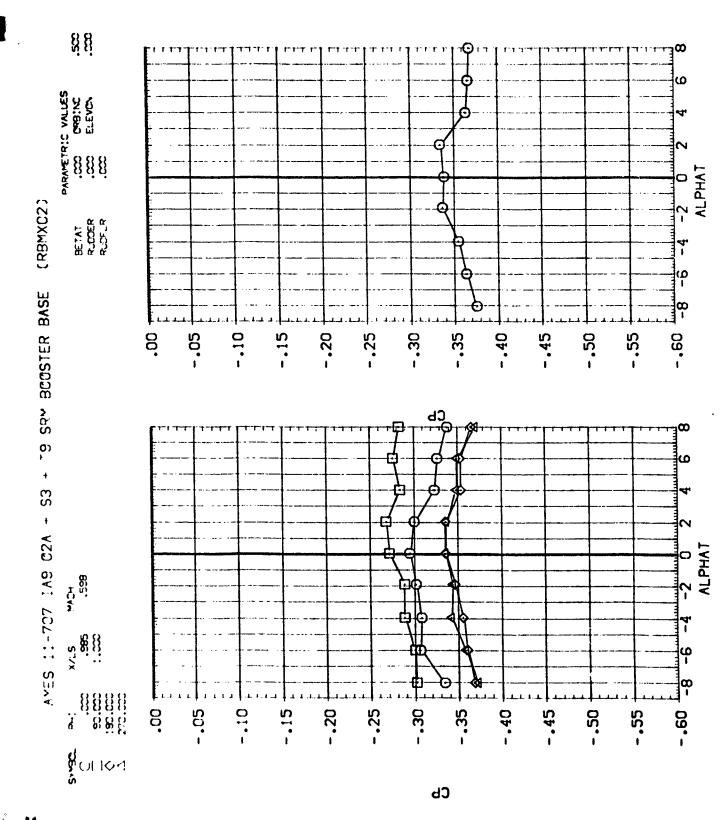
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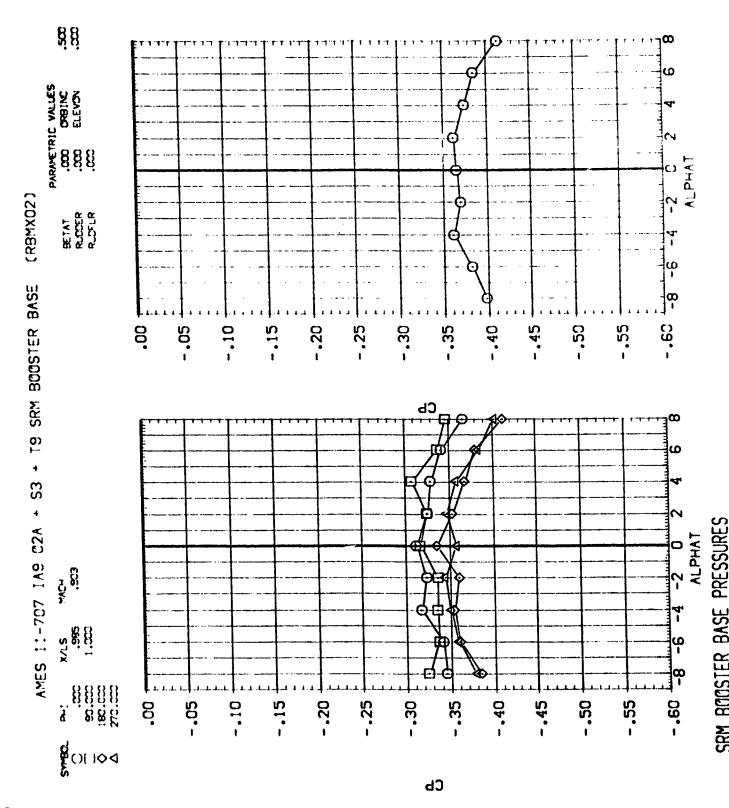




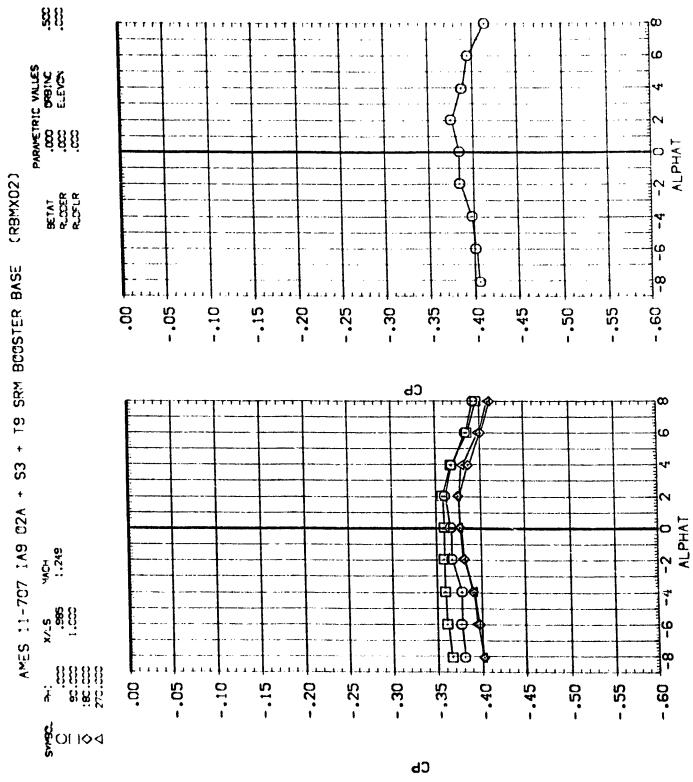




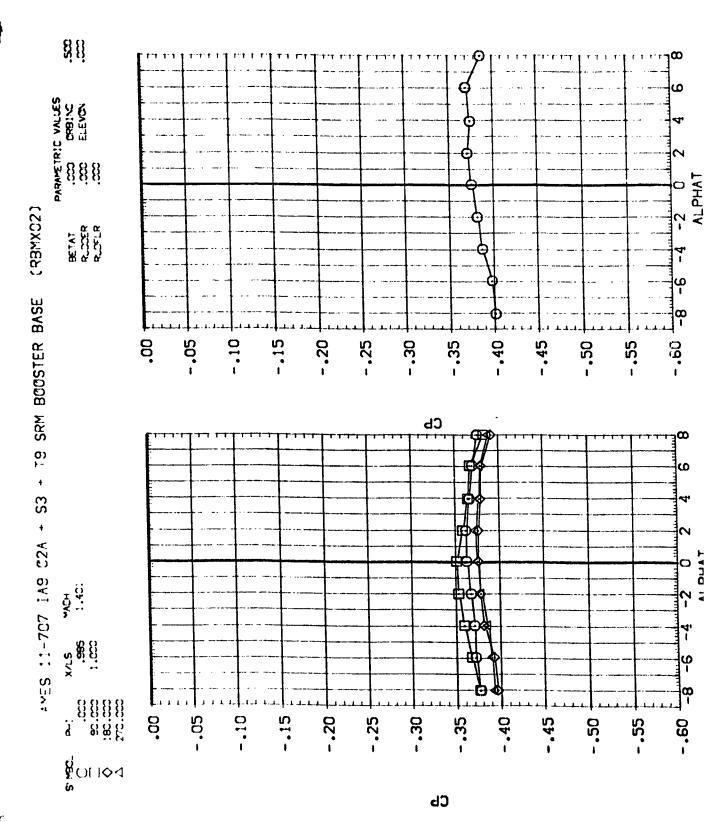
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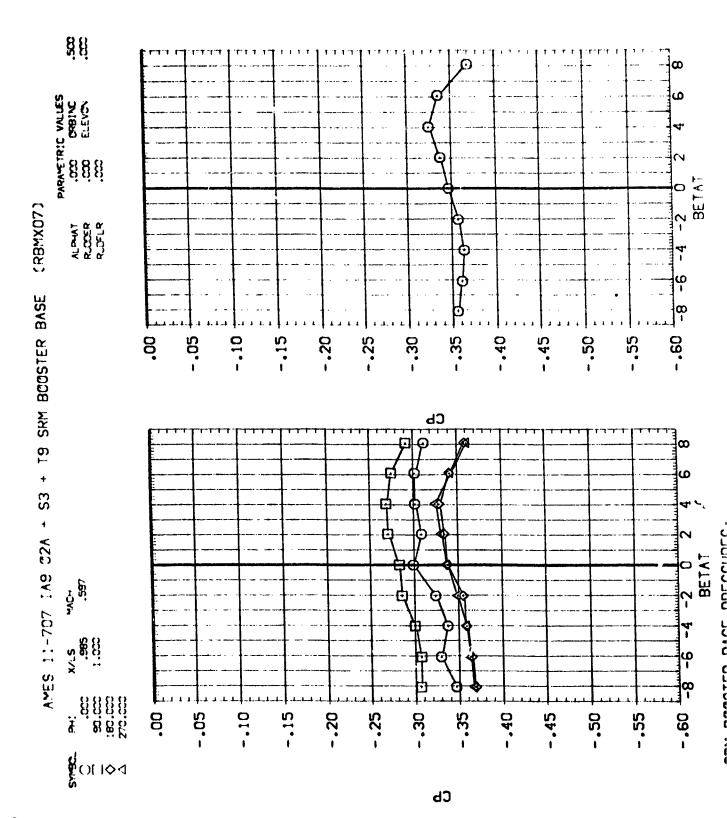
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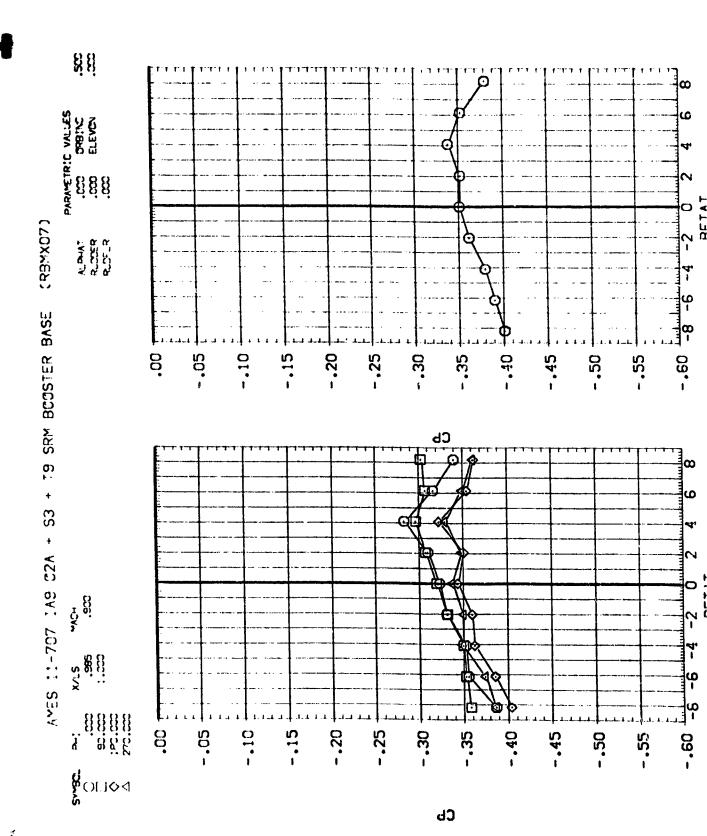


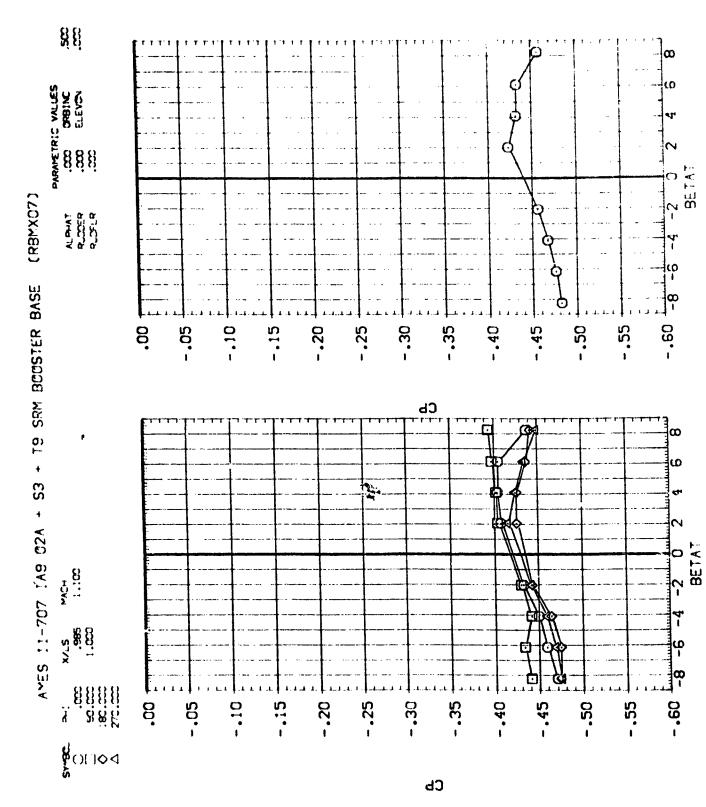
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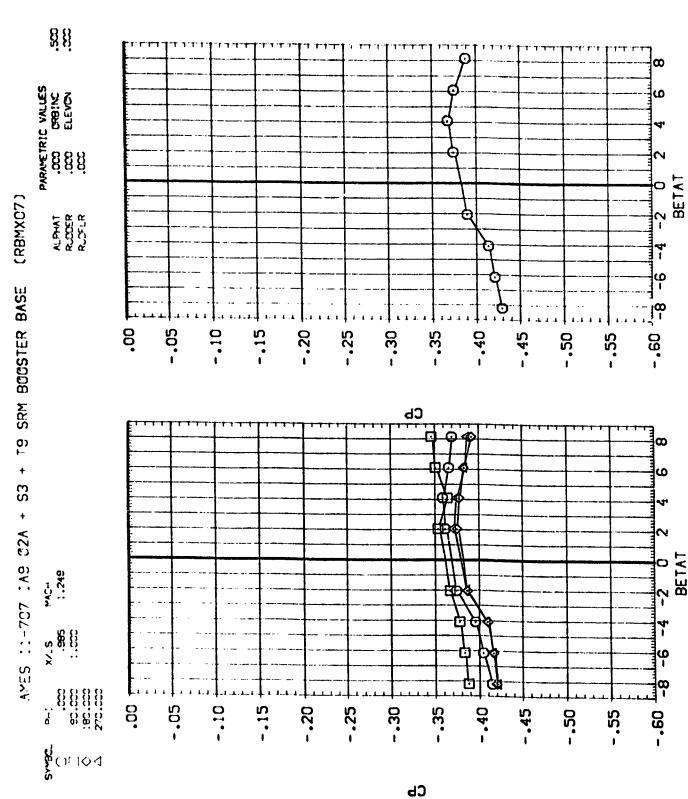
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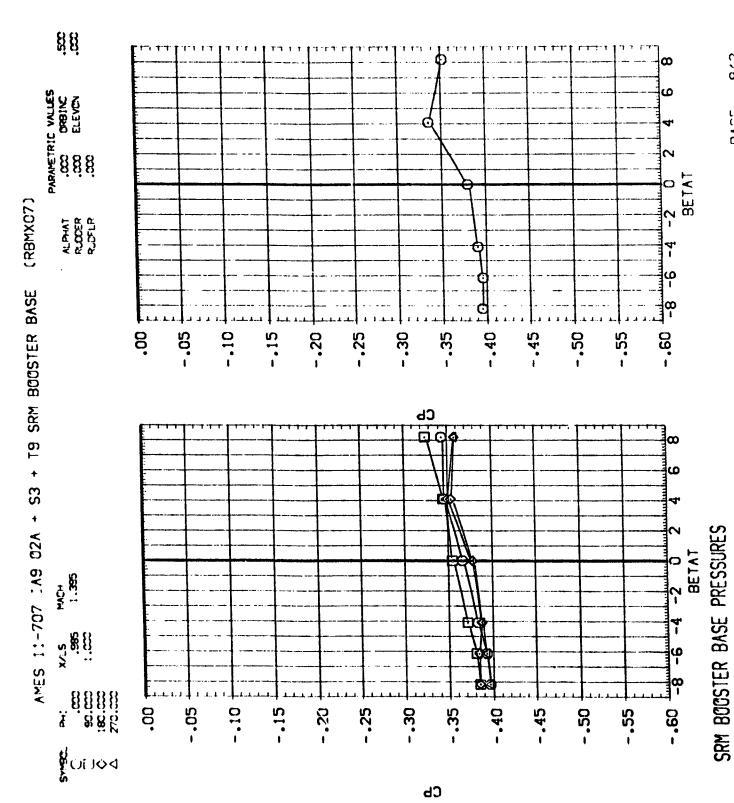


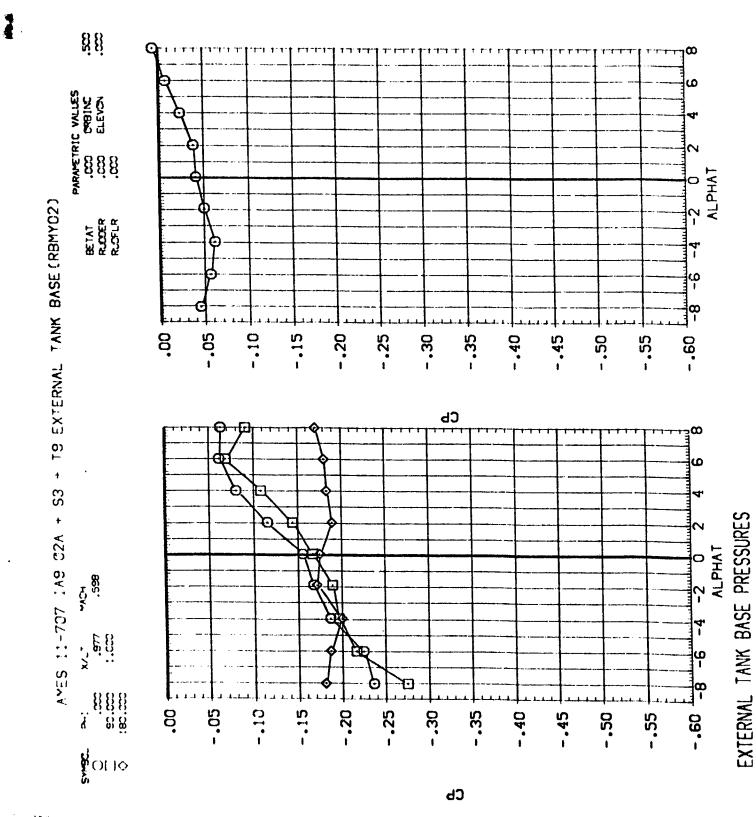




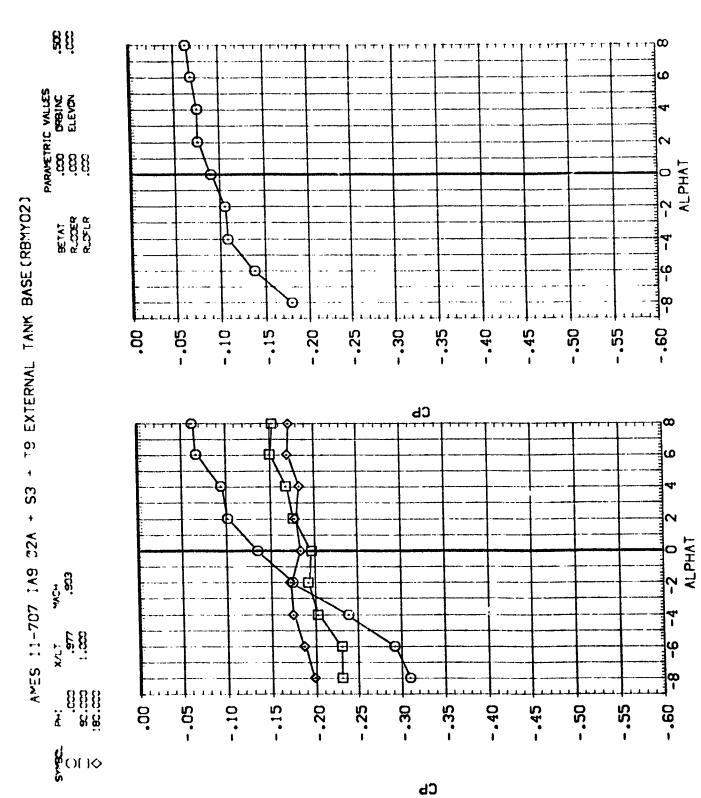


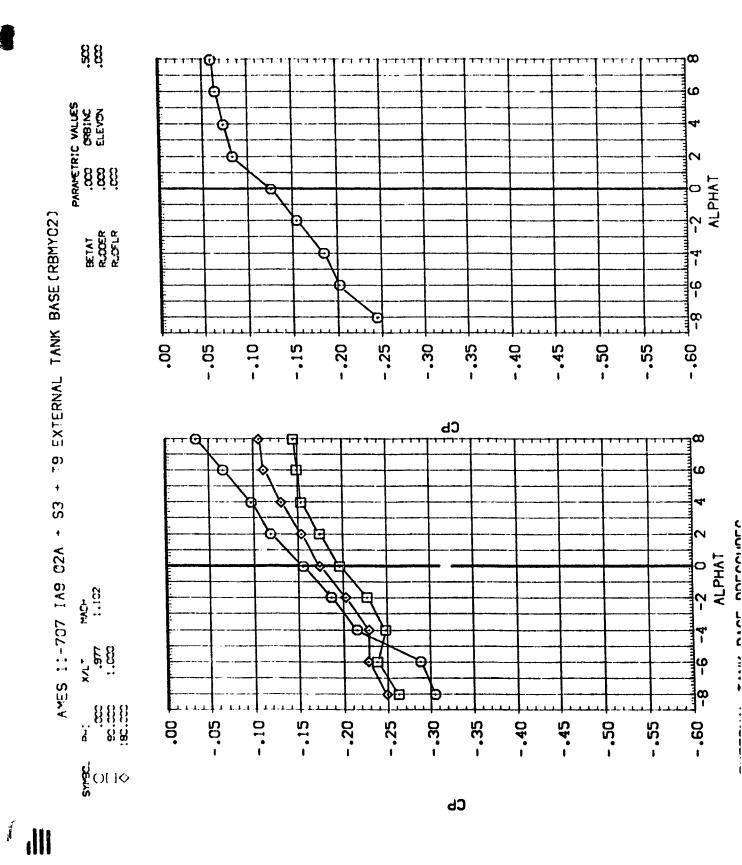
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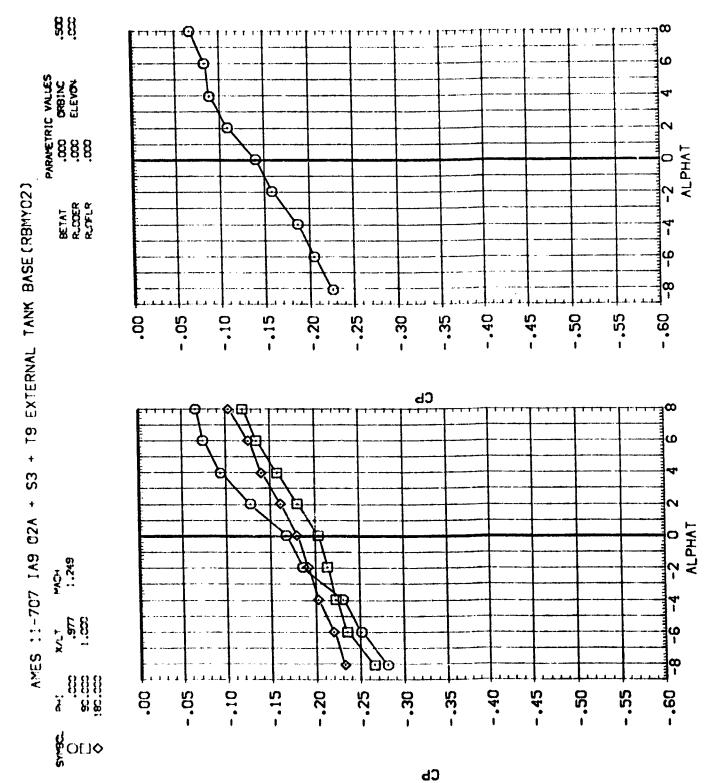


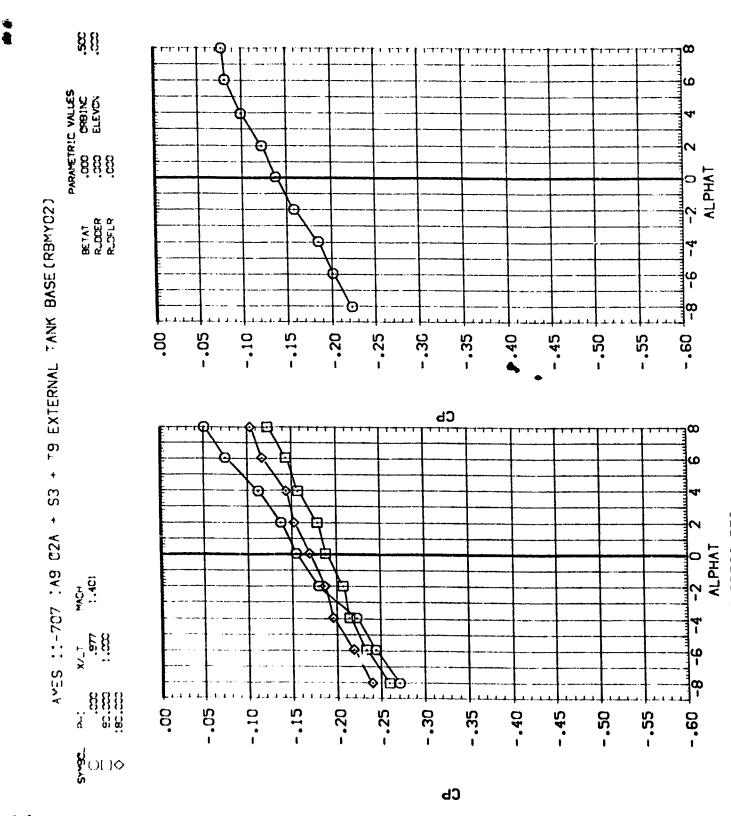
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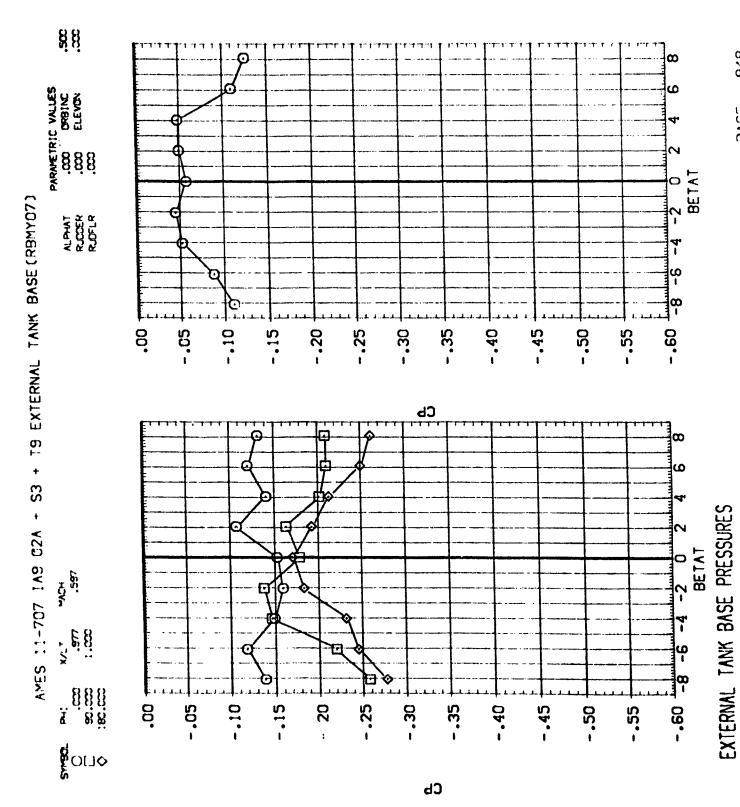




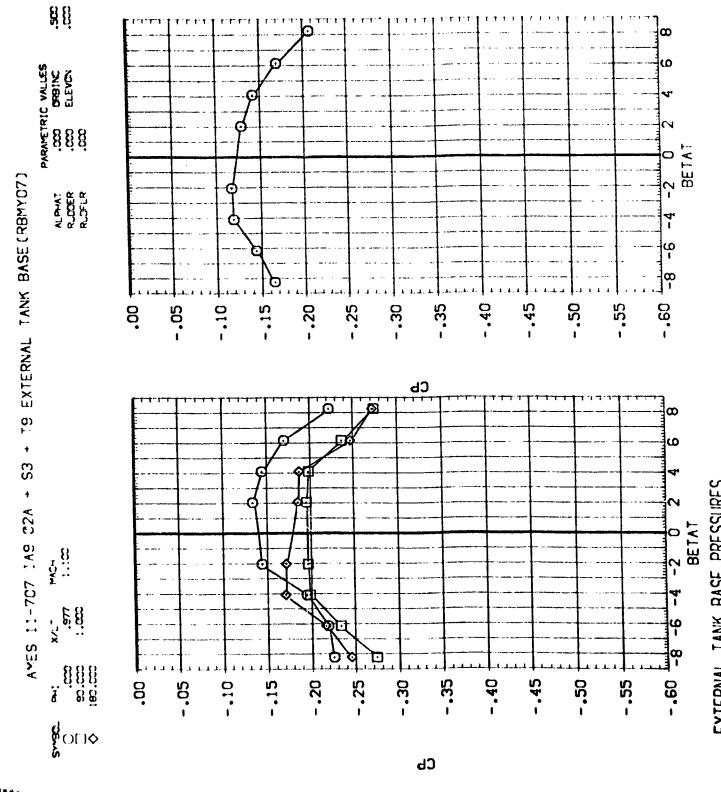
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88 PARAYETRIC VALLES
.CCC CRBINC
.CCC ELEVEN. -2 0 BETAT AVES 11-707 IA9 C2A + S3 + T9 EXTERNAL TANK BASE (RBMY07) ALPHAT PLODER PLOFIER ဖှ **φ** -.05 -.10 . 09.-8 -.15 -.30 -.35 -.20 -.25 -.55 -.40 -.45 -.50 d) œ BETAT 1047 98: မှ -.15 -. `.J. 8 -.05 -.10 - 30 -.25 -,35 -.40 -.45 09.--.50 -.55 S OF IC СЬ



88 PARAMETRIC VALUES
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